NAVY
SBIR FY08.2 PROPOSAL SUBMISSION INSTRUCTIONS

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of Naval Research (ONR). The Director of the Navy SBIR Program is Mr. John Williams, john.williams6@navy.mil. For general inquiries or problems with electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8AM to 5PM EST). For program and administrative questions, please contact the Program Managers listed in Table 1; **do not** contact them for technical questions. For technical questions about the topic, contact the Topic Authors listed under each topic on the website before **19 May 2008.** Beginning 19 May, the SITIS system (http://www.dodsbir.net/Sitis/Default.asp) listed in section 1.5c of the program solicitation must be used for any technical inquiry.

TABLE 1: NAVY ACTIVITY SBIR PROGRAM MANAGERS POINTS OF CONTACT

Topic Numbers	Point of Contact	Activity	Email
N08-103 thru N08-114	Mr. Paul Lambert	MARCOR	sbir.admin@usmc.mil
N08-115 thru N08-157	Mrs. Janet McGovern	NAVAIR	navair.sbir@navy.mil
N08-158 thru N08-185	Mr. Dean Putnam	NAVSEA	dean.r.putnam@navy.mil
N08-186	Ms. Bree Hartlage	NAVSUP	bree.hartlage@navy.mil
N08-187	Ms. Erica Bukva	NSMA	bukva.erica@mail.navy.mil
N08-189 thru N08-195	Mrs. Tracy Frost	ONR	tracy.frost1@navy.mil
N08-196 thru N08-198	Mr. Steve Stewart	SPAWAR	steve.stewart@navy.mil
N08-199 thru N08-200	Mr. Charlie Marino	SSP	charles.Marino@ssp.navy.mil

The Navy's SBIR program is a mission-oriented program that integrates the needs and requirements of the Navy's Fleet through R&D topics that have dual-use potential, but primarily address the needs of the Navy. Companies are encouraged to address the manufacturing needs of the Defense Sector in their proposals. Information on the Navy SBIR Program can be found on the Navy SBIR website at **http://www.onr.navy.mil/sbir**. Additional information pertaining to the Department of the Navy's mission can be obtained by viewing the website at **http://www.navy.mil**.

PHASE I GUIDELINES

Follow the instructions in the DoD Program Solicitation at **www.dodsbir.net/solicitation** for program requirements and proposal submission. Cost estimates for travel to the sponsoring activity's facility for one day of meetings are recommended for all proposals and required for proposals submitted to MARCOR, NAVSEA, and SPAWAR. The Navy encourages proposers to include, within the 25 page limit, an option which furthers the effort and will bridge the funding gap between Phase I and the Phase II start. Phase I options are typically exercised upon the decision to fund the Phase II. For NAVAIR topics N08-115 thru N08-157 the base amount should not exceed $80,000 and 6 months; the option should not exceed $70,000 and 6 months. For all other Navy topics the base effort should not exceed $70,000 and 6 months; the option should not exceed $30,000 and 3 months. **PROPOSALS THAT HAVE A HIGHER DOLLAR AMOUNT THAN ALLOWED FOR THAT TOPIC WILL BE CONSIDERED NON-RESPONSIVE**.

The Navy will evaluate and select Phase I proposals using the evaluation criteria in section 4.2 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications, and followed by commercialization potential. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

One week after solicitation closing, email notifications that proposals have been received and processed for evaluation will be sent. Consequently, e-mail addresses on the proposal coversheets must be correct

The Navy typically awards a firm fixed price contract or a small purchase agreement for Phase I.

PHASE I SUMMARY REPORT

In addition to the final report required in the funding agreement, all awardees must electronically submit a non-proprietary summary of that report (and without any proprietary or data rights markings) through the Navy SBIR website. Following the template provided on the site, submit the summary at: **http://www.onr.navy.mil/sbir**, click on "Submission", and then click on "Submit a Phase I or II Summary Report". This summary will be publicly accessible via the Navy's Search Database.

NAVY FAST TRACK DATES AND REQUIREMENTS

The Fast Track application must be received by the Navy 150 days from the Phase I award start date. Phase II Proposal must be submitted within 180 days of the Phase I award start date. Any Fast Track applications or proposals not meeting these dates may be declined. All Fast Track applications and required information must be sent to the Technical Point of Contact for the contract and to the appropriate Navy Activity SBIR Program Manager listed in Table 1 above. The information required by the Navy, is the same as the information required under the DoD Fast Track described in section 4.5 of this solicitation.

PHASE II GUIDELINES

Phase II proposal submission, other than Fast Track, is by invitation only. If you have been invited, follow the instructions in the invitation. **Each of the Navy Activities has different instructions for Phase II submission. Visit the website cited in the invitation to get specific guidance before submitting the Phase II proposal**.

The Navy will invite, evaluate and select Phase II proposals using the evaluation criteria in section 4.3 of the DoD solicitation in descending order of importance with technical merit being most important, followed by the qualifications, and followed by commercialization potential. Due to limited funding, the Navy reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

Under the new OSD (AT&L) directed Commercialization Pilot Program (CPP), the Navy SBIR program will be structuring more of our Phase II contracts in a way that allows for increased funding levels based on the projects transition potential. This will be done through either multiple options that may range from $250K to $1M each, substantial expansions to the existing contract, or a second phase II award. For currently existing phase II contracts, the goals of the CPP will primarily be attained through contract expansions, some of which may significantly exceed the $750K recommended limits for Phase II awards not identified as a CPP project. All projects in the CPP will include notice of such status in their Phase II contract modifications.

All awardees, during the second year of the Phase II, must attend a one-day Transition Assistance Program (TAP) meeting. This meeting is typically held in the summer in the Washington, D.C. area. Information can be obtained at http://www.dawnbreaker.com/navytap. Awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

As with the Phase I award, Phase II award winners must electronically submit a Phase II summary (without any proprietary or data rights markings) through the Navy SBIR website at the end of their Phase II.

A Navy Activity will not issue a Navy SBIR Phase II award to a company when the elapsed time between the completion of the Phase I award and the actual Phase II award date is eight (8) months or greater; unless the process and the award have been formally reviewed and approved by the Navy SBIR Program Office. Also, any SBIR Phase I contract that has been extended by a no cost extension beyond one year will be ineligible for a Navy SBIR Phase II award using SBIR funds.

The Navy typically awards a cost plus fixed fee contract or an Other Transaction Agreement for Phase II.

PHASE II ENHANCEMENT

The Navy has adopted a Phase II Enhancement Plan to encourage transition of Navy SBIR funded technology to the Fleet. Since the Law (PL102-564) permits Phase III awards during Phase II work, the Navy may match on a one-to-four ratio, SBIR funds to funds that the company obtains from an acquisition program, usually up to $250,000. The SBIR enhancement funds may only be provided to the existing Phase II contract. If you have questions, please contact the Navy Activity SBIR Program Manager.

PHASE III

Public Law 106-554 and the 2002 Small Business Innovation Research Program Policy Directive (Directive) provide for protection of SBIR data rights under SBIR Phase III awards. Per the Directive, a Phase III SBIR award is any work that derives from, extends or logically concludes effort(s) performed under prior SBIR funding agreements, but is funded by sources other than the SBIR program. Thus, any contract or grant where the technology is the same as, derived from, or evolved from a Phase I or a Phase II SBIR/STTR contract and awarded to the company which was awarded the Phase I/II SBIR is a Phase III SBIR contract. This covers any contract/grant issued as a follow-on Phase III SBIR award or any contract/grant award issued as a result of a competitive process where the awardee was an SBIR firm that developed the technology as a result of a Phase I or Phase II SBIR. The Navy **will** give SBIR Phase III status to any award that falls within the above-mentioned description, which includes according SBIR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR Phase I/II effort(s). The government's prime contractors and/or their subcontractors shall follow the same guidelines as above and ensure that companies operating on behalf of the Navy protect rights of the SBIR company.

ADDITIONAL NOTES

Proposals submitted with Federal Government organizations (including the Naval Academy, Naval Post Graduate School, or any other military academy) as subcontractors will be subject to approval by the Small Business Administration (SBA) after selection and prior to award.

Any contractor proposing research that requires human, animal and recombinant DNA use is advised to view requirements at website http://www.onr.navy.mil/sci_tech/ahd_usage.asp. This website provides guidance and notes approvals that may be required before contract/work may begin.

PHASE I PROPOSAL SUBMISSION CHECKLIST:

All of the following criteria <u>must be met</u> or your proposal will be REJECTED.

____1. Make sure you have added a header with company name, proposal number and topic number to each page of your technical proposal.

____2. Your technical proposal has been uploaded and the DoD Proposal Cover Sheet, the DoD Company Commercialization Report, and the Cost Proposal have been submitted electronically through the DoD submission site by 6:00 a.m. EST 18 June 2008.

____3. After uploading your file and it is saved on the DoD submission site, review it to ensure that it appears correctly.

____4. For NAVAIR topics N08-115 thru N08-157, the base effort does not exceed $80,000 and 6 months and the option does not exceed $70,000 and 6 months. For all other proposals, the Phase I proposed cost for the base effort does not exceed $70,000 and 6 months and for the option $30,000 and 3 months. The costs for the base and option are clearly separate, and identified on the Proposal Cover Sheet, in the cost proposal, and in the work plan section of the proposal.

Navy SBIR 082 Topic Index

N08-148 Innovative Approaches to the Optimization of Ceramic Matrix Composite (CMC) Component Manufacturing Processes
N08-149 Variable Speed Speech Synthesis
N08-150 Very Rapid Cure Capable Resin and Optimization for Pre-Preg Process Development of Barrier or Isolation Ply Materials
N08-151 Non-GPS Sonobouy Positioning System
N08-152 System for Multi-Ship Brown-Out Helicopter Landings
N08-153 Digital Method for Improved Custom Hearing Protection Equipment
N08-154 Innovative Approaches for Evaluating Interlaminar Tensile Strength of Ceramic Matrix Composites (CMCs) at Elevated Temperatures
N08-155 Real-time Spectral Band Optimization for Unmanned Aerial Systems (UAS) Hyperspectral Camera
N08-156 W-Band Power Amplifier Based on Wide Bandgap Technology
N08-157 Helmet Mounted Display (HMD) Symbology for Rotocraft Degraded Visual Environments
N08-158 Affordable, Lightweight, Universal, Linear Motion
N08-159 Eyesafer Fiber Laser Technology for Shipboard Defense
N08-160 Micro-Lens Array Based Night Vision Optical Components
N08-161 Foveal Imaging Night Vision System
N08-162 High-Quantum-Efficiency Photocathode Development
N08-163 Improved Extrusion and Milling Techniques
N08-164 Innovative Wide Bandgap Accelerated Life Test and Reliability Prediction
N08-165 Processing Signals In High Density Electromagnetic Environments
N08-166 Tools to Support Understanding of Information Uncertainty in Combat Operations
N08-167 Innovative Electronically Scanned Array RF-Photonic Architectures, Components and Sensors
N08-168 Improved Contact Association
N08-169 Radar Power Sources and Power Conditioning
N08-170 Innovative Power Amplifier Gate Thermal Management for Active Radar Systems
N08-171 Reliable Acoustic Path Vertical Line Array
N08-172 High-Efficiency Solid-State S&X-Band Radar Power Amplifiers
N08-173 Intelligent Network Traffic Management
N08-174 Interoperability and compatibility techniques for Counter Radio controlled IED Electronic Warfare (CREW) and other Radio Frequency Communication
N08-175 Wideband Conformal Antenna
N08-176 Non-Lethal Swimmer Deterrent
N08-177 Offboard Refueling Support System for Unmanned Surface Vehicles
N08-178 Weld Monitoring Quality
N08-179 Robust Deployable Superstructure Enclosure System
N08-180 Adhesives for Rapid Outfitting and Insulation Attachment
N08-181 High Efficiency and High Power Quality Electrical Power Conversion
N08-182 Autonomous Hull Inspection
N08-183 Next generation Combat System Development Approach
N08-184 Automated System (H/W & S/W) Test and Repair Tool
N08-185 Compact, Low Cost, Highly Reliable, Optical Tank Level Sensing System
N08-186 Sensitive Passive Radio Frequency Identification (RFID) Tag Development
N08-187 Pressure Sensitive Adhesive (PSA) Development
~~N08-188 Edge Bonding of Infrared Windows~~
N08-189 Gloves for diver thermal hand protection in cold water environments
N08-190 Air-sea flux, Turbulence, Aerosol and Wave Measurement System
N08-191 Metamaterials for Acoustic Cloaking
N08-192 Comprehensive data-reduction and analysis package for cloud and precipitation particle imager data
N08-193 Tactical Bioluminescence Navigation Aid
N08-194 Tethered Antennas for Unmanned Underwater Vehicles (UUVs)
N08-195 Next-Generation Marine Atmosphere Observing Instrumentation
N08-196 An Asynchronous SINCGARS (Single Channel Ground and Airborne Radio System) Frequency Hopping Notch Filter Based on Canceller Technology

Navy SBIR 082 Topic Descriptions

N08-103 TITLE: Autonomic Logistics Tactical Logistics Data Communcation Network

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: Embedded Platform Logistics System (EPLS) - ACAT III

OBJECTIVE: This topic is seeks to support two key DoD technology areas, primarily in the Information Systems Technology area supporting development of communications and networking technologies in a mobile tactical environment. In addition the topic supports Ground Vehicles by supporting the development of a real-time situational awareness capability. Specifically, the topic seeks technology to develop and test mobile data communication networks and data management software that will communicate the status of tactical assets in the area of operations and provide in-transit visibility of supporting logistics operations. When tactical assets, such as ground vehicles, are equipped with an embedded sensing and reporting capability they will need to be linked into a communications network that moves timely status information off the platform and to a command platform that can transmit the consolidated data throughout, up and out of theater. The objective is to solve the data reporting problem that exists because of lean communications in the tactical area of operations.

DESCRIPTION: The Autonomic Logistics (AL) Program has the requirement to report logistic information in near real time from each platform/asset within its local unit, up through the area of operations, to the theater and strategic levels beyond. When achieved, this will greatly increase the visibility of actual operational demands and logistic requirements of platforms during operations. With such situational awareness available, the tactical commander now knows how much “fight” is left within his weapons platforms; just as importantly, Logistics planners now readily and accurately know the “sustainment requirements” of in theater units. AL is currently deploying an embedded platform logistic system (EPLS) that will monitor and process individual platform logistic status. This status consists of data elements including: platform health, ammunition and fuel levels, and mobile load information. However, A robust, dynamic, secure communication infrastructure will be required to collect and move this data from the individual platforms. The data will then need to be compiled and rolled up to the command platform to be monitored and transmitted to the theater and strategic levels.

A dynamic, robust, and secure mobile communication network infrastructure will allow the collection and reporting of logistic information between platforms assigned to specific missions. For example the vehicles in a convoy need to be able to transmit individual platform health and status data to a master or command vehicle while on the move with out interfering with tactical operational communications. Another application would support a Light Armored Vehicle (LAV) platoon on a mission where the vehicles are scattered around a specific battle space. Each vehicle should be able to report status and health data back to the command vehicle as they move around the battle space beyond line-of -sight of the command vehicle. A current mesh network design does allow extend range by transmitting through other nodes which demonstrates the advantage of mesh networking. However, we need to develop an affordable data communications system or architecture to support operations in the dynamic or sometimes chaotic tactical environment. The communication network system must be rapidly reconfigurable and allow the acceptance / departure of additional authenticated nodes on the fly. It needs to be able to reliably maintain connection while on the move in all types of terrain including rural and urban areas of operation. Through this innovative research effort we expect to be able to develop a communication architecture that will transmit the data off the platform to establish real-time situational awareness for operational and logistics commanders. The challenge is to reliably collect and consolidate platform health and status data from a number of highly mobile platforms/nodes in a tactical environment. An affordable logistics data network architecture that can support the tactical security, bandwidth, and connectivity requirements without interfering with tactical operational communications has not been developed. In this tactical environment we expect to have platforms/nodes on the move that will drop in and out of connectivity, interference from terrain, man-made obstacles, other communications. The platform data will have to be synced when connectivity is restored without loss of data. The master or command node/platform will need to be able to consolidate the data, populate an onboard Common Operating Picture (COP), and then redirect/transmit the data to a higher level COP via radios or satellite communications. This product will increase the visibility of the tactical level logistic requirements like identifying the support request for repair parts/consumables and tracking of mobile load distribution events from individual systems. The mobile network architecture will support software that includes business rules allowing the network to recognize new nodes on the fly and provide a status of nodes connectivity. This dynamic capability could also be expanded to support Identification Friend or Foe (IFF) between nodes/platforms.

PHASE I: During Phase I we will determine, the scientific and technical approaches for completing the following tasks:
1) Development of a cost effective robust tactical data Communication network capability for transmitting Vehicle health and status in support of Operational and logistics commanders situational awareness.
Network robustness refers to the overall capability and reliability of the network to perform in the anticipated con-ops. Specific concerns include:
1) Dynamically changing topologies resulting from mobile nodes.
2) Scalability with respect to the number of nodes/vehicles in the network and increasing traffic/ network overhead data.
3) Wireless node range and interference with other wireless devices in the ISM bands
4) Meeting Navy/Marine Corps wireless security protocols and requirements
5) Network needs to be "Self Organizing". All nodes shall have routing capability for network traffic. This routing is constantly updated as nodes move about and as nodes join and leave the network. This shall be done automatically as part of the infrastructure and requires no external control.
6) The network must be capable of supporting at a minimum the bandwidth requirements of the EPLS data package. Ideally the bandwidth should be sufficient to support voice and video transmissions.
7) The network architecture must be capable of syncing data from platforms/nodes that was collected when connectivity was lost without loss of data.

PHASE II: Develop proof-of-concept demonstrators of systems to conduct each task separately or simultaneously.

PHASE III: Integrate proof-of-concept demonstrators with existing AL/EPLS systems and demonstrate.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications would include industrial and municipal potential. Affordable robust Communication networks could extend wireless connectivity to areas currently not practical to provide coverage. The Transportation Industry could provide improved monitoring of Fleet vehicles. The Railroad industry could monitor the cars on trains as they drop and add rail cars. Municipalities could network fleet vehicles for more reliable and redundant monitoring and communications in remote locations. Further development of this capability would improve costs and reliability of these systems allowing for consumer use and benefits.

REFERENCES:
1. Initial Capabilities Document for AL

2. AL Critical Design Document (Draft)

3. EPLS Specification

KEYWORDS: Autonomic Logistics, Embedded Platform Logistics System, Net-centric Communications, Situational Awareness. Logistics Data Communication Architecture.

N08-104 TITLE: Development of Single-Layer Universal Combat Uniform Material

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

ACQUISITION PROGRAM: PM Infantry Combat Equipment, ACAT III

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: To develop a single-layer Universal combat uniform material proven to endure in any environment including Chemical Biological (CB), rain / snow / ice resistant (WR), flame resistant (FR) and high heat. Typical protective garments such as the current fielded garment (JSLIST) and other developmental concepts use double layer construction consisting of outershell and inner liner that provides CB protection to users in the field. The ultimate uniform is bulky, heavy and very expensive due to the two-layer configuration design, it's like sewing two uniforms into one. Therefore, effort would be to offer single–layer configuration such to produce a lightweight uniform incorporating CB, WR and FR protection. FR protection would need to be equivalent or better than existing, similar weight commercial FR fabrics.

DESCRIPTION: Use of a Universal Combat material offering CB, WR, and FR protections would be ideally suited for rapid deployment. With compact vacuum package capabilities the uniform can travel easily within cargo pocket, MOLLE, or other means into combat situation. The single layer textile design would offer a highly breathable lightweight comfortable concept uniform in either typical shirt / trouser, coverall i.e. CVC or other design so designated by USMC designers. Garment would be significantly reduced in bulk, weight and requires significantly less sewing. It would be lightweight and comfortable enough to be worn in place of the standard uniforms.

PHASE I: Determine, insofar as possible, the scientific and technical approaches for completing the following tasks: Universal material would possess a level of carbon based / nano-tube additives or other novel means that would effectively assure the current 24 hour CB level of continuous protection from a liquid challenge of 10 gm/square meter against chem. agents HD, GD, and VX after 45 days of wear (720 hours cumulative hours). Fibers shall be inherently FR to provide that form of protection and subsequent WR or Silicone finish would provide a highly protective water-repellency. Uniforms fabricated from Universal fabric would provide high degree of breathability, be lightweight and be capable of providing 45 day wear life. Additionally this material technology can be manufactured into a lightweight single layer chemical duty uniform in lieu of an overgarment and can be tailored to protect against reduced chemical agent challenge levels.
Universal material would possess a high degree of field durability and be launderable up to 25 X's w/ drying and / or be dry cleanable. Material would address durability issues such as pilling, abrasion, strength, tear resistance, comfort, breathability, water-repellency (WR), Flame-Resistance (FR) at highest possible protection, hand, dyeing / printability and other properties. The goal is develop a garment offering maximum flame and heat radiant protection that is Berry Amendment compliant (Made in USA).
Minimum 5 – 10 yards material would be submitted for full laboratory testing and several uniforms of USMC design for full CB and FR manikin testing.

PHASE II: Develop proof-of-concept uniforms from large scale run of Universal material under field trial conditions. Uniform design and number ranging from 200 -400 uniforms or various combination of uniforms would be submitted as demonstrators for material.

PHASE III: Commit to large scale production capabilities according to Berry Amendment requirements.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Universal material would be suitable for nuclear or other anti-toxic cleanup applications. Furthermore, technologies could be separated for material to possess all three protections, two or even single use. WR and FR protections would be used for outdoor commercial markets such as tentage, tarps and other covers. Material would have multi-service applications and could be extended for CB protective tentage and commercial markets for hunting and other outdoor recreation activities.

REFERENCES:

1. MIL-PRF-MCCUU ATT 1 DTD 12 AUG 2004

2. MIL-PRF-MCCUU ATT 2 DTD 18 ARP 2006

KEYWORDS: Chemical Biological; Flame Resistant; Water Repellency.

N08-105 TITLE: Efficient, Low Emission Generator

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PM Expeditionary Power ACAT III

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The Marine Corps is looking for innovative design concepts to allow small (less than 5 kW) generators to run at partial loads without wet-stacking while improving overall fuel efficiency and reducing emissions. The generator must operate on JP-8 and high sulfur diesel fuels while meeting the EPA Tier 4 engine requirements. A balance of weight, fuel efficiency, reliability/durability and cost should be considered when selecting an approach for this topic.

DESCRIPTION: Current military generators less than 5 kW are often sized for the maximum loads experienced in a mission profile. These generators run at partial loads most of the time. The result is wet-stacking and poor fuel economy. Emissions control often uses exhaust after treatments which foul easily with high sulfur fuels used in some theaters of operation. Innovative concepts are needed to address these issues.

PHASE I: The Phase I effort should focus on scientific research and preliminary designs to be built and demonstrated in Phase II. Research should include, but not be limited to, load following engine controls, enhanced combustion, recovering and recycling unburned fuel from exhaust and hybrid power systems. The design concept selected in Phase I must work in a variety of mission profiles and environmental conditions. The system must operate at evaluated temperatures and humidity ranging from Hot (120°F) to Basic Cold (-24°F) climates and up to 95-percent relative humidity in elevations up to 8,000 feet and in harsh environments of high wind, wind-driven rain, sand, and dust. A trade study will be conducted to determine the best technical approach to be built and evaluated in Phase II. The results of Phase I will be documented in a technical report and briefed to the Marine Corps Systems Command to determine if a Phase II program should be pursued.

PHASE II: The Phase II effort will take the preliminary design generated in Phase I and produce two full sized operational prototypes for testing. The contractor shall develop a laboratory test plan to address, at a minimum: engine performance across temperature, dust, and altitude extremes; power output for regulation, quality, stability and transient response; durability testing of components and full system; and physical performance criteria for size, weight, noise, smoke, and fuel efficiency. Upon Government approval of the test plan, it shall be executed and results reported. The contractor shall make modifications as needed to successfully complete the test requirements. The contractor shall document and provide a Safety Assessment Report of the systems. At least 2 final prototypes or reconditioned/modified prototypes shall be delivered to the government after the contractor testing. These units will be used by the Government in field evaluations and the contractor shall support the evaluation with spare parts and technical advice. A final design review will be held to discuss test results and transition opportunities.

PHASE III: The contractor shall prepare a manufacturing plan and marketing plan to sell his product to the government as well as the private sector. The contractor will make the necessary teaming arrangements with the manufacturers of the components used in this product.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This system could be applied in any work environment where there is a requirement for portable power and energy systems with high transient loads and low constant loads. Any powered system that must operate in a remote location for an extended length of time would benefit from this project.

REFERENCES:
1. Novel Load Following Control of an Auxiliary Power Unit, Ximing Cheng; Fengchun Sun; Minggao Ouyang, Intelligent Control and Automation, 2006. WCICA 2006. The Sixth World Congress on Volume 2, Issue , 21-23 June 2006 Page(s): 8311 – 8313, Digital Object Identifier 10.1109/WCICA.2006.1713596.

2. The transient self-excitation of a switched reluctance generator, Schofield N, Long SA, Source: JOURNAL OF APPLIED PHYSICS 97 (10): Art. No. 10Q501 Part 3, MAY 15 2005.

3. Automotive Fuel Economy: How Far Can We Go?, Committee on Fuel Economy of Automobiles and Light Trucks, National Research Council.

4. Hybrid Power System with a Controlled Energy Storage, Eduard Muljadi, Senior Member, IEEE, Jan T. Bialasiewicz, Senior Member, IEEE.

5. Continuous Combustion General Purpose Engine System, Jerry E. Kashmerick, Kashmerick Engine Systems, LLC and Timothy A. Shedd, University of Wisconsin-Madison.

KEYWORDS: Wet-Stacking; Hybrid Power; Load Following; Recycling Unburned Fuel; Fuel Efficiency; Low Emissions.

N08-106 TITLE: Miniature Rapid Accurate Non-Magnetic Azimuth Sensor

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Weapons

ACQUISITION PROGRAM: Fire Support Systems ACAT IV

OBJECTIVE: This topic seeks technology to determine azimuth for a hand-held and tripod mounted targeting system. The sensor shall not depend on the earth's magnetic field, GPS, or triangulation to determine the observer to target azimuth as referenced to True North. The sensor shall be small enough such that it can be integrated into targeting systems, be able to determine azimuth within a minimum set-up time, and accurate enough to enable the use of precision guided weapons at long standoff ranges. There are handheld systems currently fielded and under development that provide ideal platforms for immediate transition for this technology.

DESCRIPTION: Current precision guided weapons far exceed the target location accuracy that is generated by the combination of a handheld laser range finder, digital magnetic compass, and GPS for self location. These weapons require accuracy greater than 10 meters TLE. The system must obtain 2 mil accuracy to meet the TLE requirement at a standoff range of 5km. The goal of this SBIR is to replace the digital magnetic compass with an azimuth sensor that does not depend on the earth's magnetic field, or GPS, or triangulation to determine the observer to target azimuth as referenced to True North, nor rely on any of these technologies to assist in determining True North. The sensor must be designed such that it can not be electronically jammed nor magnetically interfered; but can be either integrated into or attached to existing and future man-portable targeting equipment in future GWOT and battlefield environments.. The sensor may be incorporated into a tripod. Size, weight, accuracy, and setup time are of primary importance.

PHASE I: Determine, insofar as possible, the scientific and technical approaches for completing the following tasks:
- Determine the sensor components, trade-offs (including size, weight, power consumption, setup and measurement time, etc) required to achieve 2 mil (one sigma) azimuth sensor.
- Determine a method to interface the sensor with existing and future laser range finders and laser designators.
- Investigate tactics, techniques, and procedures necessary to use the sensor system.

PHASE II: Develop proof-of-concept demonstrators of system. Fabricate prototype sensors and evaluate the sensor as an integrated part to its parent system.

PHASE III: Integrate proof-of-concept demonstrators with existing laser range finder and designator systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Application to recreation and other sporting activities, rescue operations and anything else the requires determination of direction. Many commercial applications would benefit from a rapid and highly accurate miniature azimuth sensor. These include, but are not limited to: survey equipment, wireless communications, personal navigators such as GPS equipped cell phones or PDA's, land and sea transportation and recreation equipment.

REFERENCES:
1. Initial Capabilities Document for the Joint Effects Targeting System.

2. Operational Requirements Document for the Advanced Eyesafe Rangefinder Observation Set.

3. Operational and Organizational Concept for a Target Location, Designation and Handoff System.

N08-107 TITLE: Flexible Body Armor

TECHNOLOGY AREAS: Materials/Processes, Battlespace, Human Systems

ACQUISITION PROGRAM: Family of Ballistic Protective Systems PM Infantry Combat Equipment ACATIV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: This topic seeks a lightweight flexible body armor system incorporating a shear thickening fluid or other technology that provides NIJ-IV level protection. The system shall be capable of providing protection from M80, APM2, M855, M993, and M995 rounds at muzzle velocity. The system shall provide flexibility for movement within the torso. The ballistic ensemble weight should not exceed 8 lbs/sq.ft. The flexible ballistic plates shall be resistant to adverse effects associated with aging, wear, and exposure to environmental factors such as humidity, moisture, extreme temperatures, and UV light.

DESCRIPTION: The rigid chest plate worn with the flexible vest as part of the body armor inhibits natural movement in the torso. The Marine Corps seeks ballistic protection that provides NIJ Level IV protection, but is flexible to allow for increased movement within the torso. The system should be compatible with the current and future USMC personal protective equipment (PPE).

PHASE I: Determine, insofar as possible, the scientific and technical approaches for the completion of the tasks:
- Determine suitable materials to enhance the ballistic performance of the material without adversely affecting weight, comfort, or flexibility.
- Provide a comprehensive analysis of the ballistic properties of this material.

PHASE II: Develop proof-of-concept demonstrators of systems to demonstrate possible configurations and properties within, including high energy ballistic impact testing.

PHASE III: Integrate proof-of-concept demonstrators with existing fielded protective equipment.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has application is the tactical and law enforcement sector to improve concealable body armor and vests currently in use. This technology facilitates movement, increasing the survivability and lethality of personnel in the law enforcement and military sector.

REFERENCES:
1. "New Body Armor Technology Aids Athletes". 25 February 2006. <http://www.cbsnews.com/stories/2006/02/25/ap/tech/mainD8FVRME0E.shtml>.

2. "How Liquid Body Armor Works". 21 December 2007. <http://science.howstuffworks.com/liquid-body-armor1.htm>.

KEYWORDS: Ballistic; impact; armor; polymer; fragmentation; shear thickening.

N08-108 TITLE: Wireless Battery Charging Methods for Distributed Soldier electronic Devices

TECHNOLOGY AREAS: Ground/Sea Vehicles, Electronics

ACQUISITION PROGRAM: PM Expeditionary Power Systems and PM Marine Expeditionary Rifle Squad

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop the capability to wirelessly recharge batteries in mission critical equipment such as thermal weapons scopes to reduce Warfighter mobility limitations imposed by extensive electrical wiring.

DESCRIPTION: The United States Marine Corps has begun employing an operational concept entitled Distributed Operations. Using dispersed and highly mobile forces that can rapidly mass on critical nodes, greater capability can be employed. At the smallest level of employment, the Distributed Operations Squad employs a host of pieces of equipment that use multiple power and energy sources. Many of these devices use rechargeable batteries, but not the same style batteries. Current domestic and international soldier modernization programs are attempting to provide a centralized power for all electronic power consuming devices from a single power source to reduce weight and increase redundancy. However, the introduction of a centralized power source has lead to a growth in electrical connections and wiring that now prohibitively limits Warfighter mobility while also introducing new fault pathways, such as connector breakage, into the Warfighter system. This topic seeks innovative approaches to applying technologies to provide efficient and direct recharge of critical electronic equipment, such as remote mounted thermal weapons scopes, by means of wireless, connector-free electrical interfacing via inductive coupling or other possible means. Low system cost, satisfactory human and electrical component safety, high energy transfer efficiency, as well as low ovcerall total system weight (to include batteries, chargers, interconnectivity, etc.) are paramount.

PHASE I: Evaluate methodologies, such as high efficiency inductive couplings, and solutions to most efficiently (size, weight, energy transfer etc.) recharge distributed portable electronics via wireless energy transfer from a centralized power source for critical items such as thermal weapon scopes. This study shall address all critical items designated by USMC at program initiation that are carried on the Marine. At the completion of phase one there shall be trade-studies, preliminary designs and models, technical characteristics, and graphical representations of all proposed technology solutions. At program initiation, the Government will provide a set of critical mission equipment to target. Phase One Option efforts will address physical full-scale (non-working required, working desired) mockup representations of all proposed items.

PHASE II: Demonstrate and deliver a prototype wireless recharging system using the system concept developed in Phase I. This prototype must be rugged, deployable on military aircraft and ships, fully supportable worldwide, and reliable.

PHASE III: Develop final design and commercialization plans from the info gained during Phases I and II.

PRIVATE SECTOR COMMERCIAL POTENTIAL: Many electronic items employed by the Distribution Operations Squad are commercial based items. Novel means to electrically recharge distributed portable electronics from a centralized power source is of growing interest in the commercial sector. Several companies have developed wireless recharging products for mobile electronic devices such as cell phones and toothbrushes. This effort will lead to higher efficiency wireless charging, reduced costs, and improved ruggedness for operation in military environments.

REFERENCES
1. http://www.marcorsyscom.usmc.mil/sites/pmeps/BMAS.asp

2. www.dtic.mil/ndia/2004issc/wednesday/richter.ppt

3. http://www.siemon.com/us/white_papers/02-03-22-emi.asp

4. http://www.splashpower.com/Press/News_Oct_2002.html

KEYWORDS: wireless power distribution; wireless battery recharging

N08-109 TITLE: “Smart Dust” and Nanotechnology for Joint Weapons Systems Diagnostics/Prognostics

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: Automatic Test Equipment - ACAT III

OBJECTIVE: Develop highly integrated,ultra-miniature, non-obtrusive, wireless, sensory systems for greatly enhanced weapons systems diagnostics to the Light Armored Vehicle (LAV). These micro-miniature technologies would aid greatly in the collection of on-system weapons systems information for diagnostics and prognostics purposes. This will tie into current Joint Service efforts such as GCSS/GCCS by providing unparalled visibility into the status and maintenance condition of a specific weapons system platform.

DESCRIPTION: Maintainers lack visibility into their equipment beyond any built in test or embedded diagnostics capability that the weapon system might possess. Recent advances in microelectrical-mechanical systems(MEMS) and nanotechnology should allow the integration of a class of devices small enough to be rapidly placed on legacy equipment with minimal/no visible alterations to the equipment itself.

When maintenance is performed, having ultraminiturized sensor capability within the system would provide precise knowledge of the system condition and allow dramatically increased diagnostics capability, with rapid pinpointing of the system’s problem. Therefore, accuracy, speed of diagnosis, and unprecedented visibility into weapons systems behavior and possible incipient failure would be aided by this type of technology.

This effort would combine the latest in state-of-the-art micro- and nano-system device and integration technologies into an autonomous smart micro/nanosensor device for application to diagnostics/prognostics monitoring of legacy DoD ground based vehicles and telecommunications equipment.
The resulting devices will explore a variety of current/emerging micro and nano sensor technologies. They will employ sensor fusion capability, include networkability through common standards such as the IEEE 1451 standard, provide extremely low power and short range wireless capability (using multiple technologies based on need and environment, i.e. RF, infrared, UWB, et.), and make use of emerging power scavenging techniques for extended lifetime. This system could potentially be adaptable to any weapon system or equipment within the DoD.

PHASE I: Develop a concept for the smart dust sensor type for the LAV and a separate processing node device capable of interfacing with potentially hundreds or thousands of smart dust sensors. For the purpose of this initial effort, the conceptual design shall be capable of accommodating of up to 50 sensors. This design will include the overall device architecture concept and implementation, and communication protocols. The initial sensorial focus will be on current,voltage, and temperature sensing. The concept will also consider the range of emerging power scavenging and sourcing technologies to help dramatically extend operational lifetimes.(i.e. vibration, heat, sound, voltage, isotopic, current power scavenging). Consideration of a larger common data processing node device to be able to collate the information from the ‘net’ of sensors. Environmental constraints posed by the mix of climates and conditions (mud, oil, sand, moisture etc.) encountered worldwide to these sensors will be explored and the methods considered to provide mitigation. Standardized systems engineering concepts for this technology will be proposed that stabilize sensor placement methodologies and other considerations.

PHASE II: Using prototype sensors and processing node prototype, network test a autonomous smart dust technology for diagnostics on a specific DoD system (such as LAV or other systems). This phase will also include selection of a candidate DoD system for initial tests of prototypes, and the documenting of the diagnostic requirements of that system. The prototype smart dust devices will employ multiple sensors, and will be integrated into the LAV system for tests. Using economies of scale technologies such as employed by the semiconductor industry, consideration will be given to create a set of adaptable technologies that will drive eventual costs to be a dollar or less per wireless, multi-capable sensor. Size consideration goal is for a complete sensor class each smaller than an aspirin. The processing node technology will be capable of communication to a maintainer or via emerging maintenance shared data environments such as GCSS.

PHASE III: Design and employ a series of smart dust systems providing diagnostics/prognostics technologies of unprecedented penetration and low cost for commercial, DoD and Federal Government applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Devices of the type developed in this effort would find wide-spread application in commercial activities involving fleets of in-service equipment such as the airline and shipping industries, as well as any systems requiring remote sensing.

REFERENCES:

1. "Smart dust protocols for local detection and propagation" ACM Workshop On Principles Of Mobile Computing Proceedings of the second ACM international workshop on Principles of mobile computing Toulouse, France, Pages: 9 - 16, Year of Publication: 2002. ISBN:1-58113-511-4.

2. "Intelligent Sensor Validation and Fusion with distributed (MEMS Dust) Sensors", Shijun Qiu*, Dept of Mechanical and Electrical Engineering
Xiamen University, China, Alice M. Agogino, Jessica Granderson
Department of Mechanical Engineering, University of California, Berkeley.

3. "Smart Sensor Networks", David Rees, Smart Sensing Project CSIRO Telecommunications and Industrial Physics, March 04, 2002, TIPP 1476.
http://www.smartspaces.csiro.au/docs/SmartSensorNetworks.doc.

4. "AAAV Prognostic System Trade Study" Power Scavenging Technology
Conducted by Penn State ARL, January 15, 2003.

KEYWORDS: MEMS, Nanotechnology, Microsystems, Power Scavenging, Condition-based Maintenance, Microsensors, Nanotubes.

N08-110 TITLE: <u>Hollow Fiber Freeze Thaw Filter</u>

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PM Infantry Combat Equipment

OBJECTIVE: Research and test a practical method for preventing damage to hollow fiber water filtration media subjected to freezing and thawing. A practical method must NOT make the resultant system so heavy and bulky as to negate the weight and size advantage of hollow fiber filtration media.

DESCRIPTION: Hollow fiber (HF) water filtration media is comprised of many small diameter thin walled polysulfone tubes with porous walls arranged in a housing. This allows packing a very large filter area in a very small and lightweight container. This filtration media is the first with a low enough pressure drop to allow a soldier to drink directly through a reasonably sized filter without undue effort.

Hollow fiber filtration media has a significant shortcoming: The current versions do not survive freezing and thawing consistently. Current research suggests that the mechanism of damage is not rupture due to the expansion of the water as it freezes but mechanical damage done by ice crystal growth. A practical method to prevent this damage must be found if the weight and size advantages of hollow fiber are to be realized.

The Marine Corps desires an individual water purifier (IWP) filter capable of withstanding freezing conditions and maintaining performance upon thawing.

The current Marine Corps IWP block I filter uses 1,150 0.5mm diameter x 0.1mm wall hollow fiber microfilter tubes packed into a 33mm diameter x 55mm long housing. The hollow fiber is looped and both ends of each fiber are potted into polyurethane. The flow is from the outside of the fiber to the inside of the fibers, then out at the potting. This configuration yields a flow rate of 1.0 (liter per minute,lpm)at a pressure drop of 1.0 psi with a pore size of 0.2 micron (microfilter). Total weight of the HF module including housing and potting is about 50 grams.

A "practical" filter system would not increase the weight and/or bulk by more than 50%. The solution could be anything from a stronger fiber to an active system to prevent the water from freezing. The most successful system will increase the weight and bulk the least and not require any additional consumables.

PHASE I: Evaluate the freeze behavior and confirm the failure mode of the hollow fibers. Identify and rank freeze/thaw alternatives.

PHASE II: For top three alternatives, manufacture freeze/thaw filter prototypes and test in the lab under freezing conditions. Thaw filters and verify microbiological performance.

PHASE III: Downselect and pick best candidate solution for freeze/thaw filter capability. Produce 300 to 400 filter samples and test under field conditions.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Civilain outdoor/camping activities as well as survial environments represent an extremely large market of theis capability.

REFERENCES:

KEYWORDS: Hollow fiber; filtration; filter; water filtration; water purifier; freeze/thaw alternatives.

N08-111 TITLE: Objective Live-Training Infantry Performance Metrics for Automated After Action Review

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: PMTRASYS ACAT III

OBJECTIVE: To investigate and develop computer-based infantry team performance assessment tools that utilize objective data captured during live training, that can be integrated into After-Action Review systems, and that automate the tagging of events where feedback on team performance would be desired by Marine Corps instructors.

DESCRIPTION: Live training remains the preferred method of training for Marine Corps infantry operations. However, live training exercises are often too long (lasting hours to days), and too large (both in the number of trainees and the physical field of operations) for instructors to view, process, and provide feedback on all of the training relevant events that take place. A single building clearing exercise in urban combat training, for example, could involve anywhere from 13 to 40 trainees moving in a distributed, but coordinated manner, both outside and inside the building – with trainees searching and engaging hostile or neutral role-players in multiple rooms and on multiple floors at the same time. More and more live training facilities are being instrumented with both video-recording and trainee tracking systems, however, unprocessed recordings of live training exercises are often too large to be of use for timely After Action Review (AAR).

Computer-based tools are needed to analyze time series and/or discrete event data, identify deviations from desired team performance, and automatically annotate video-recordings or other data logs. Analyses comparing coordinated movement through an exercise to those previously identified from expert behavior datasets, for example, could be used as a means to “flag” instances where coordination breaks down (Jirsa and Kelso, 2005). Instructors could then construct AAR feedback more quickly by screening just these instances. Other sources of data in training exercises that may be recorded and available for computer-based analyses might include audio communications, and the timing, source, and site of impact for shots fired (Lampton et al, 2005, Salas et al., 2007). A system capable of identifying deviations from desired team performance would enable Marine Corps instructors to screen large training logs for rapid preparation of AAR materials.

PHASE I: Conduct a study that (1) identifies and demonstrates computational algorithms for recognizing deviations from desired team performance based on team movement, communications, and/or discrete actions within a live room-clearing exercise; and (2) proposes a framework for expanding these methods to handle team performance assessment in an indoor/outdoor live urban combat environment.

PHASE II: Implement the proposed framework and demonstrate its effectiveness in assessing live team performance as part of an AAR system. Ideally, development and validation of the team performance assessment algorithms would be carried out with Marine Corps subject matter expert input and guidance.

PHASE III: Refine and integrate the validated framework and its associated systems into Marine training facilities.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Successful development of the proposed team training assessment technologies should have application within commercial and industrial facilities where coordinated and cohesive team performance enhances safety, improves productivity, and/or offers significant cost savings.

REFERENCES:
1. Lampton, DR, Cohn, JV, Endsley, MR, Freeman, J, Gately, MT, Martin, GA. “Measuring Situation Awareness for Dismounted Infantry Squads: Automated assessment and feedback strategies.” Volume: 2005 INTERSERVICE/INDUSTRY TRAINING, SIMULATION & EDUCATION CONFERENCE (I/ITSEC).

2. Jirsa VK, Kelso JAS “The excitator as a minimal model for the coordination dynamics of discrete and rhythmic movement generation.” JOURNAL OF MOTOR BEHAVIOR 37 (1): 35-51 JAN 2005.

3. Salas E, Rosen MA, Burke CS, Nicholson D, Howse WR. “Markers for enhancing team cognition in complex environments: The power of team performance diagnosis.” AVIATION SPACE AND ENVIRONMENTAL MEDICINE 78 (5): B77-B85 Suppl. S, MAY 2007.

KEYWORDS: Team training; live training; behavior; team coordination; team cohesion; team communication.

N08-113 TITLE: <u>Electrochemical Oxidation Technology</u>

TECHNOLOGY AREAS: Materials/Processes, Human Systems

ACQUISITION PROGRAM: PM Infantry Combat Equipment, ACAT IV

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OBJECTIVE: Research and test alternatives to existing industry standard electrochemical (EC) technology used in portable water purification applications. Evaluate operational performance based upon resistance to anode contaminates, increased current densities, effectiveness at removing microbiological organisms and minimizing/optimizing electrode substrate thickness and size.

DESCRIPTION: The generation of on-demand disinfection solution for individual-use water treatment requires an EC technology. Current ECs utilize conventional dimensionally stable anodes (DSA) to generate free available chlorine for disinfecting drinking water. DSAs perform well in batch and flow-through ECs, but are susceptible to premature anode failure when questionable salt is utilized as feed electrolyte to the cell. Current research shows that

Hi-performance electrodes (HPE), such as boron doped diamond, offer several advantages to the user, including reduced cost, fewer consumables, and longer life. While recent research indicates the improved possibilities, the design parameters and resulting chemical constituents have not been rigorously proven.

Novel EC technologies with the ability to perform longer under adverse conditions are sought. Metrics for success will include resistance to corrosion and fouling relative to existing technologies, ability to produce effective advanced oxidants, such as ozone or hydroxyl radicals, size, and cost. Performers will demonstrate the ability to meet these criteria by building prototypes and conducting rigorous testing. Cost considerations will also contribute to engineering design. Methods to determine engineering success will include fouling tests and evaluation of optimal operational parameters for extended product life. Methods to determine disinfection effectiveness will be based upon removal of microbiological organisms within the drinking water.

PHASE I: Evaluate the best EC performing materials. Build prototype electrolytic cells for concept demonstration.

PHASE II: Incorporate lessons learned from prototype electrolytic cells and perform stringent comparative efficacy tests on up to 10 promising EC technology candidates. Stringent efficacy tests should include metrics that assess engineering performance, and effectiveness against microorganisms.

PHASE III: Build four units for field evaluation. Collect and evaluate field evaluation data, and obtain user feedback. Conduct cost trade off analysis for most cost effective balance that meets user needs. Build eight units from this design user trials, and acceptance by the end user as a viable system for incorporation in the field and for full-production and commercialization runs.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Development of the technology represents the potential to be low-cost for individual water purification. Products could easily be commercialized and used by outdoor enthusiasts and international travelers where water at the point of entry to buildings is often suspect.

REFERENCES:

KEYWORDS: Electrochemical; EC; portable water purification.

N08-114 TITLE: Anodizing of Aluminum Parts for Small Arms

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: ACAT III

OBJECTIVE: Develop innovative approaches for anodizing large numbers of small parts, fabricated from aluminum alloys, without the need for individual racking of parts.

DESCRIPTION: The Marine Corps processes a large number of small parts for small arms, and imparts corrosion protection and aesthetic qualities to those parts by anodizing. The parts of interest include but are not limited to bellcranks, M16 receivers, trigger housings, door mounts, and hinge brackets. The alloys of interest include those from the 5xxx and 7xxx series, as well as 355-T6 and 356-T6. Currently, the small parts are racked using compression on aluminum prongs, on racks with successive prongs, or on finger-like attachments. However, the racking process is time consuming and inefficient, and the Marine Corps seeks a batch process for anodizing large numbers of small aluminum parts. The key drivers for anodizing parts are uniformity, with avoidance of surface problems such as burning and formation of powdery deposits. The desired thickness of the anodized layer is 0.001 + 0.0002 to 0.002 + 0.0003 mils. Sometimes a clear anodized layer is required, although typically a black matte dye is used. The uniformity of the anodized layer is determined using visual appearance of color when dyes are used, for example, MIL-STD-595 for M16 receivers.

This topic requests innovative approaches that can meet the need for bulk anodizing of small parts. The robustness of the manufacturing technology will be established by the range of parts that can be anodized using a non-racking approach, and the uniformity of the anodized layer on the parts. The need for high reliability and reproducibility of the anodized coating is paramount, and will be established by rigorous testing.

PHASE I: Based on a part that is representative of the small parts typically anodized by the Marine Corps, design and build a small-scale fixture for bulk anodizing. Demonstrate proof-of-concept of the proposed bulk anodizing approach using this fixture and part. Identify a range of parts that could be tested in a Phase II program. Provide a conceptual design of prototype hardware that will be built in the Phase II program for pilot-scale bulk anodizing.

PHASE II: Build upon the Phase I work to produce prototype hardware for pilot-scale anodizing of small parts in Phase II. Optimize the anodizing process and develop a library of process parameters that cover anodizing requirements for a wide range of parts. Perform testing of the anodized parts and compare the performance and reliability of those parts with those obtained with state-of-the-art anodizing processes. During this Phase II program, work closely with the DoD to ensure that military specifications will be met by this technology.

PHASE III: The offeror shall work with a DoD prime contractor to transfer the pilot-scale capability to full-scale production.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology will have application to the commercial marketplace, which requires robust, high-reliability anodizing and manufacturing technologies.

REFERENCES:
1. MIL-A-8625: Anodic Coatings for Aluminum and Aluminum Alloys
KEYWORDS: Aluminum anodizing, small parts, small arms, manufacturing

N08-115 TITLE: <u>Rugged and Durable Fiber Optic Replacement</u>

TECHNOLOGY AREAS: Air Platform, Information Systems, Electronics

ACQUISITION PROGRAM: F-35-Joint Strike Fighter; ACAT I

OBJECTIVE: Develop a rugged and durable drop-in fiber replacement that would provide a versatile platform for a number of photonic network-centric military avionic network applications.

DESCRIPTION: Fiber optic networks in aircraft are becoming a reality. Aviation requirements such as shock, vibration, thermodynamic, and fleet maintenance make this technology deployment extremely challenging. A fiber based backplane fabric serves as a basic foundation for the mission computer intercommunication paths. Furthermore, ribbon fiber suitable for pigtailing fiber optic transceivers mounted on circuit card assemblies serves as the basic interconnect between active optoelectronic components and fiber based backplanes. This type of fiber interconnect is subjected to tight bending and is currently very fragile and requires meticulous handling by the board designers. Some of the fibers are routed throughout the aircraft with convoluted tubing as protection. A more durable, reliable, and compact fiber optic replacement that is equivalent to or higher in performance that the current fiber material is needed to meet the military adverse environmental conditions.

The new material should require less cable protection than the current silica-based fiber optic material due to its higher strength characteristic and resistance to breaking due to handling. The new material will be applied to both digital (1 to 10 Gb/s) and analog (to 20 GHz) fiber optic systems, including both fixed wavelength (i.e., 850 nm, 1300 nm, 1550 nm) and multiwavelength (i.e, wavelength division multiplex (WDM)).

Selection criteria for the replacement material must be based on durability, reliability, affordability, and drop-in fiber replacement performance. The fiber optic devices must be capable of both 2.5 and 10 Gb/s data transmission in an avionic representative 50, 62.5 and 100 micron graded index multimode core and 9 micron mode field diameter single-mode fiber optic cable plant environment (i.e., –55 to +165 ºC ambient operational temperature range, 100 meter long transmission distance).

PHASE I: Design and develop alternative cable plant material that can replace current fiber optics.

PHASE II: Develop and test a prototype new fiber replacement package over the full – 40 to +100 oC ambient temperature range.

PHASE III: Demonstrate that the new fiber optic material will perform within the specified range in adverse environments and transition it to a military platform.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Private sector applications include computer and telecommunication networks incorporating fiber optic interconnects.

REFERENCES:
1. Beranek, M.W.; Avak, A. R.; and Van Deven, R. L., "Military Digital Avionics Fiber Optic Network Design For Maintainability And Supportability," IEEE Aerospace and Electronic Society Systems (AESS), vol. 21, no. 9, pp. 18-24, 2006.

2. Glista, Jr., A. S. and Beranek, M. W., "Wavelength Division Multiplexed (WDM) Optical Technology Solutions For Next Generation Aerospace Platforms," IEEE/AIAA 22nd Digital Avionics Systems Conference Proceedings, 2003.

3. Beranek, M.W., "Fiber Optic Interconnect And Optoelectronic Packaging Challenges For Future Generation Avionics," Proceedings of SPIE, Vol. 6478, pp. 647809-1 to 647809-18, 2007.
KEYWORDS: Fiber Optics; Interconnect; Networks; Wavelength Division Multiplexer (WDM); Telecommunication; Multi-Wavelength.

N08-116 TITLE: <u>Open Data Distribution Service (DDS) for use in a real time simulation laboratory environment</u>

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PMA-231; E-2 Hawkeye Early Warning and Control Aircraft; ACAT I

OBJECTIVE: Use Open DDS, consistent with the Object Management Group (OMG) specification, to provide an open architecture solution to interprocess communications between real-time simulation applications and services.

DESCRIPTION: The OMG adopted the Common Object Request Broker Architecture (CORBA) as a standard means to promote distributed computing. The military and other industries attempted to use CORBA in real time situations and discovered it did not support distributed computing in a real time environment. Other approaches were deployed to support simulations: Distributed Interactive Simulation, High Level Architecture, etc. Over the years, data centric publish and subscribe tools were developed to foster distributed computing in a real time environment. The recent Data Distribution Service specification represents documentation of a standard for those types of products. The goal is to determine if a DDS-like approach could be used within a distributed simulation environment.

PHASE I: Determine the technical feasibility of using an open source DDS implementation in a distributed simulation environment. Define and determine the capabilities of the DDS, specify a Software Developer's Kit (SDK) for distributed simulation laboratories, identify required testing to validate the SDK, and identify the required maintenance to keep the DDS functioning with evolving technology.

PHASE II: Develop, demonstrate and validate an SDK based on the Phase I design. Test for latency in representative applications. Adapt the SDK for different operating system hosts, and demonstrate a production ready sample, to include a distributed simulation application framework and associated development artifacts, such as UML or Data Flow diagrams.

PHASE III: Integrate the DDS middleware into an existing distributed simulation laboratory environment using the SDK. Develop a production quality, automated tool for generating much of the DDS code from existing C/C++ header files.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The application of this technology would be applicable to any hardware in the loop simulation laboratory that currently uses HLA and DIS tools. Further, the code generation tool is applicable to any C/C++ application wanting to use the DDS middleware for its interprocess communications.

REFERENCES:
1. "Data Distribution Service for Real-Time Systems Specification" http://www.omg.org/cgi-bin/doc?formal/07-01-01.

2. "An open standards approach to real-time COTS-based simulator design", Dr. Rajive Joshi; http://www.embedded.com/columns/technicalinsights/190300032?_requestid=628713.

3. "DDS and Distributed Data-centric Embedded Systems", Stan Schneider; http://www.ddj.com/embedded/196601852.

KEYWORDS: Data Distribution Service; Distributed Simulation; Open Standards; Real Time Middleware; Data-Centric Publish-Subscribe; Quality of Service (QoS); Data Location Reconstruction Layer (DLRL).

N08-117 TITLE: <u>Rapid Tactics Development Using Existing, Low-Cost Virtual Environments</u>

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: PMA 205 - Aviation Training Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop capabilities that allow existing, low to medium fidelity virtual environment technologies to rapidly create human behavior models to support experimentation, training and analysis of air and subsurface tactics.

DESCRIPTION: Traditional human behavior model development processes are slow and expensive. The process typically begins with some form of knowledge acquisition; the goal being to capture what the behavior's functions are. This data is often captured in the form of a requirements document, a conceptual model, a task analysis, etc. The data is then used by an analyst or engineer to design the human behavior model. The design specifies how the model will perform the required functions. The design must consider the user interface, the operating environment, the required inputs and outputs, performance characteristics, and other details. Once the design is approved, the development, integration, and testing processes iterate until the model is complete.

Various techniques have been employed to attempt to reduce the time and cost of developing human behavior models (and software in general). Minor improvements have been achieved through abstraction, reuse, and other strategies. Major improvements are needed in the ability to apply knowledge directly to the solution. There is too much ambiguity and opportunity for human error in current practices. Furthermore, our enemies are adapting at a rate that exceeds our ability to appropriately respond using traditional methods.

Virtual environments provide an opportunity for subject matter experts to apply their knowledge directly to the human behavior development solution. This SBIR seeks the development of processes and technologies to leverage existing, low-cost virtual environments in the development of human behavior models. The objective is for subject matter experts to create new human behavior models by executing them in a virtual environment. For example, rather than defining, designing, building, and testing a new air to air tactic using traditional methods, an operator could simply execute the tactic in an existing virtual environment. The resulting "behavior" can then be captured and adapted/replayed for experimentation, training, and/or analysis.

This effort must leverage existing, low-cost COTS/GOTS (Commercial Off-the-Shelf/Government Off-the-Shelf) virtual environments and simulation tools. Examples include, but are not limited to, Delta3D, Microsoft Flight Simulator, SIMbox, Sub Command, etc. The ability to capture the behavior, replay it, and apply it in alternative ways (e.g. on different military platforms, in different geographic environments, in different tools, etc.) is imperative. Simulation-independent solutions are preferable. Although the initial application of the process/technology is in the air and subsurface domain, a domain-independent solution is desired. Consideration should also be given to existing Navy standards for modeling, simulation, and interoperability.

PHASE I: Determine the feasibility of and design a non-functional architecture for capturing, replaying, and altering human behavior models developed using virtual environments. The architecture should clearly articulate the functions, interfaces, and relationships between the components and how they will achieve the desired objectives.

PHASE II: Further develop the architecture and demonstrate its ability to implement, capture, replay, and augment air and subsurface human behavior models.

PHASE III: Integrate Phase II capabilities into the Navy's modeling and simulation architecture.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology will be directly applicable to federal aviation, law enforcement, and homeland defense organizations. Current training systems require extensive time and money to update/create human behavior models. This SBIR, if successful, will deliver simple, effective tools for the development of human behavior models that are readily extensible for use in other environments.

REFERENCES:
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2. Steinfeld, Aaron; Fong, T; Kaber, D; Lewis, M; Scholtz, A; Scholtz, J; Goodrich, M. (2006). Common Metrics for Human-Robot Interaction. NASA Publications. http://ic.arc.nasa.gov/publications/pdf/1135.pdf.

3. Corey, M.; Traumy D; Laney C. Swartouty, W; Marsellaz S.; Gratchy J; Van Lenty, M. (2006). Teaching Negotiation Skills through Practice and Reflection with Virtual Humans. Information Sciences Institute University of Southern California. http://people.ict.usc.edu/~lane/papers/jmst-saso-xai.pdf.

4. Goodman, B; Drury, J; Gaimari, R; Kurland, L; Zarrella, J. (2006). Applying User Models to Improve Team Decision Making. MITRE TECHNICAL REPORT, Center for Integrated Intelligence Systems, Bedford, Massachusetts. http://www.mitre.org/work/tech_papers/tech_papers_07/06_1351/06_1351.pdf.

5. MAGY SEIF EL-NASR and BRIAN K SMITH. Seif El-Nasr, M; Smith, B. (2005). Learning through Game Modding. Penn State, Information Sciences and Technology. http://faculty.ist.psu.edu/SeifEl-Nasr/conference/LearningByBuilding-SeifEl-NasrSmith.copyed.pdf.

KEYWORDS: Modeling; Simulation; Human Behavior; Training; Intelligence; Games.

N08-118 TITLE: Development of Methodology for Moving Body Simulation Based on Computational Fluid Dynamics

TECHNOLOGY AREAS: Air Platform, Weapons

ACQUISITION PROGRAM: F-35 Joint Strike Fighter Program Office, ACAT ID

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OBJECTIVE: Develop innovative approaches for a time-accurate computational fluid dynamic (CFD) solution for moving bodies with control surfaces.

DESCRIPTION: CFD can be used to certify a store for safe release from the parent aircraft. In this approach, grids around the aircraft and stores need to be generated. For the past 20 years, the structured overset grid method has been successfully applied to store separation and validated against flight test. The drawback of this method is the excessive time and effort required to generate structured grids and ensure proper interpolations for overset grids. Two to three months are required to generate and assemble structured grids for store separation analysis, which leads to a delay in store certification. There is a strong need to automate or expedite the grid generation process for faster CFD solutions to support test and evaluation in a timely manner. Recently, there have been some efforts to attack moving-body problems with unstructured overset grid and deforming unstructured grid approaches. Compared to structured grids, unstructured grids can be generated quickly. However, the unstructured grid technology is not yet mature enough to be applied to moving body problems. For unstructured overset grid methods, handling the failed interpolation grid points, called “orphan points” is still an issue. On the other hand, large deformation and excessive computational requirements are issues that still need to be resolved for deforming unstructured grid approaches. A possible approach could be the combined use of Cartesian and unstructured overset grids but other innovative solutions will also be considered.

PHASE I: Develop a methodology for moving body simulation based on CFD and demonstrate feasibility by performing simple analysis.

PHASE II: Fully implement the methodology into a usable analysis tool. Perform preliminary validation and verification through analysis and testing

PHASE III: Transition the technology to the DOD weapon community and commercial aerospace industry.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Potential commercial applications include the aerospace industry and the weapon compatibility related aerospace industry.

REFERENCES:
1. Pandya, M. J. and Frink, N. T.: "Agglomeration Multigrid for an Unstructured-Grid Flow Solver,” AIAA 2004-0759, January 2004.

2. Pandya, M. J. Frink, N.T., Abdol-Hamid, K.S., and A Chung, J.J.: "Recent Enhancements to USM3D Unstructured Flow Solver for Unsteady Flows", AIAA 2004-5201, August, 2004.

3. Pandya, M.J., Frink, N.T., and Noack, R.W.: "Progress Toward Overset-Grid Moving Body Capability for USM3D Unstructured Flow Solver,” AIAA 2005-5118, June 2005.

4. Pandya, M.J., Abdol-Hamid, K.S., Campbell, R.L., and Frink, N.T., "Implementation of Flow Tripping Capability in the USM3D Unstructured Flow Solver," AIAA 2006-0919.

5. YikLoon Lee, Jame D. Baeder, "Implicit Hole Cutting - A New Approach to Overset Grid Connectivity,” AIAA 2003-4128, The 16th AIAA Computational Fluid Dynamics Conference, Orlando, June 2003.

6. Nemec, M.N., and Aftosmis, M.J., "Adjoint error estimation and adaptive refinement for embedded-boundary Cartesian meshes,",AIAA Paper 2007-4187.

7. Murman, S.M., and Aftosmis, M.J., AIAA 2007-0074 "Dynamic analysis of atmospheric-entry probes and capsules,” AIAA Paper 2007-0074.

KEYWORDS: Store Separation; CFD, Moving Body Simulation; Cartesian Grids, Unstructured Grids; Hole Cutting.

N08-119 TITLE: Innovative Concepts for Ultra-light and Reliable Hydraulic Actuators

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: F-35, Joint Strike Fighter; ACAT I

OBJECTIVE: Develop innovative approaches for reducing the weight and improving the safety and reliability of high performance hydraulic actuators used in Navy aircraft.

DESCRIPTION: High performance hydraulic actuators are being used in new Navy fixed wing and rotary wing aircraft. Although they have been performing satisfactorily in most cases, there have been reported incidences where the actuators have been compromised or have failed. Some of these failures have been catastrophic. Also, due to unique Navy requirements, high performance hydraulic actuators are being specified in an array of access and subsystem door applications. Since most of these actuator components are fabricated from weight inefficient steels, the resulting weight penalty is significant. In addition premature failure of these components has occurred due to fatigue and wear. It is therefore desirable to develop innovative approaches that would provide for weight reduction and reliability enhancement of the actuator components.

PHASE I: Investigate innovative approaches for weight reduction and improved reliability of hydraulic actuators. Conceptually demonstrate the feasibility of the approach.

PHASE II: Utilizing the approach developed under Phase I, fully develop the prototype design and produce limited quantities of prototype actuators for component testing. Develop a manufacturing plan to produce the actuator components and provide projections of weight, cost, and maintainability.

PHASE III: Demonstrate producibility of the actuator in a production environment. Perform component qualification and certification for Navy applications

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial aircraft and the automotive industry are two areas that can benefit from low cost, durable, lightweight high performance hydraulic actuators.

REFERENCES:

1. “Lightweight Hydraulic System Development and Flight Test,” SAE Technical Paper No. 801189.

2. “Lightweight Hydraulic System Technology – 800 psi Update,” SAE Technical Paper No. 851910.

3. Frazier, W. E., “Corrosion-Resistant Alloys for Naval Aviation,” Advanced Materials and Processes, Mar. 2007, page 21.

KEYWORDS: Material Systems; High Pressure; Actuator; Material Selection; Manufacturing Processes; Subsystem.

N08-120 TITLE: Smart Gasket for Catapult Low Loss Launch Valve (LLLV)

TECHNOLOGY AREAS: Materials/Processes, Sensors

ACQUISITION PROGRAM: PMA-251, Aircraft Launch and Recovery Equipment Program Office

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OBJECTIVE: Develop innovative sensor technology and software for monitoring the health and service life of gaskets used in catapult low loss launch valve applications.

DESCRIPTION: Aircraft are currently launched aboard aircraft carriers via steam catapults, which will be around for the next 50 years. A critical component of the steam catapult is the LLLV. To maintain a tight seal and ensure there are no steam leaks, there is a gasket in the LLLV which is located between the main head and the body of the LLLV. The gasket is placed in the recess machined in the body of the valve and held in place by the head connected to the body by bolts. The bolts are torqued up to a specified preload to assure a tight connection.

The Navy is seeking a means to monitor the health of the gaskets in mission critical equipment such as the LLLV while the gasket is in operation. Specifically, sensor technology capable of sensing loss of compression pressure is required and must be sensitive enough to indicate impending failure prior to steam leakage for use in a steam catapult prognostic and health monitoring system.

The Navy will consider proposals for both in-situ sensors (i.e., part of the gasket) and inspection tools that are not part of the gasket. Suggested (if any) modifications to the LLLV must be minimal and are subject to review and approval by the Navy. The inspection must be accomplished while the gasket is in operation. Any proposed method that requires disassembly of the LLLV will not be considered.

PHASE I: Develop a conceptual design for the sensor suite. Determine the feasibility of the proposed concept to meet requirements. Include an analysis of the feasibility to manufacture the “smart” gasket with in-situ sensors and microprocessor(s) and an analysis of power source requirements (power harvesting and re-charge) and data transmission (fault indication as well as prognostic data) to a potential condition based maintenance (CBM) system.

PHASE II: Develop a “smart” gasket lab prototype and demonstrate in a test environment representative of the catapult system aboard ship.

PHASE III: Further develop a prototype for robustness and shock testing (if applicable). Test prototype in conjunction with LLLV qualification testing. Produce units for delivery to carrier fleet and shore sites, or incorporate into LLLV gasket production (whichever applies).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This type of a gasket will have great utilization in the industrial equipment where the cost of the gasket is secondary to the equipment function and safety (radioactive water leaks in nuclear reactors or steam leaks in critical valves).

REFERENCES:
1. Aircraft Carrier Reference Data Manual, NAEC-MISC-06900.

KEYWORDS: Non-Destructive Inspection; Health Monitoring; MEMs; Carrier Launch Gear; Condition Based Maintenance; Smart Gasket.

N08-121 TITLE: Weapon System Performance in Complex Radio Frequency (RF) Environments

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-290 - Maritime Patrol and Reconnaissance Aircraft

OBJECTIVE: Develop innovative tools and methods for converting and optimizing input structures of full wave electromagnetic solvers.

DESCRIPTION: Advanced electromagnetic solvers have proven an invaluable tool in analyzing RF sensor behavior on a variety of air and surface platforms. Given the cost effectiveness of these tools and the insight they provide to electromagnetic phenomena, we see their user base growing daily. The accuracy of a full-wave solver used to address these problems is directly tied to the input mesh quality. Input meshes for full wave solvers are either built manually using a geometric description of the platform and/or antenna as a reference or from an existing surface representation (e.g., Initial Graphic Exchange Specification or IGES) of the geometry of interest. Meshing tools generally create a good mesh for much of the geometry of interest; however, it is common for the meshing tool to produce low-quality mesh elements for a local area in the geometry. This is mainly due to the fact that most meshing tools are not optimized for electromagnetic problems, and some meshing algorithms have a fundamental limitation resulting in poor quality mesh elements. To compensate, the analyst can visually inspect the mesh and fix the problem areas by hand for small meshes. For a large mesh, fixing even a small percentage of the total mesh is a time-consuming task.

Innovative tools are sought that will examine an existing mesh, identify problem areas based on user specifications for edge length, aspect ratio, and connectivity, and then attempt to “fix” the mesh in the local area to meet the user’s requirements while maintaining the contour of the original mesh. After the mesh has been repaired, the tool should then identify any remaining problems and provide statistics to the user regarding the quality of the mesh.

Another problem with meshing tools that are not developed specifically for computational electromagnetics (CEM) is that they tend to generate meshes in certain areas that are much denser than necessary, resulting in many extra unknowns for the CEM solver. The proposed tool should also have the capability to isolate a section of the original mesh, where the density is higher than necessary, and generate a new, less dense mesh while preserving the vertices defining the boundary of the specified region.

PHASE I: Explore algorithms that will analyze an existing mesh and identify problem areas in the mesh based upon user specifications as well as determine if the mesh is open or closed. Research and explore algorithms for healing meshes. Determine proof-of-concept of techniques through tests on small and medium size meshes provided by NAVAIR. Investigate ideas for converting asymptotic solver meshes into full-wave solver meshes.

PHASE II: Using the most promising algorithms from Phase I, develop a prototype tool that will heal existing full-wave solver meshes and convert asymptotic solver meshes into full-wave solver meshes. This tool should include a graphical user interface (GUI) that allows the user to visualize the problem areas in the original mesh and provide statistics to the user regarding the original mesh and the healed or converted mesh.

PHASE III: Alone or with another company, develop a commercial strength gridding tool for CEM solvers.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The tool developed in this project will find applications among commercial airframe builders, automotive industry, defense contractors, antenna houses, etc.

REFERENCES:
1. P. Lancaster and K. Šalkauskas, Curve and Surface Fitting. London: Academic Press, 1986.

2. J. F. Thompson, B. Soni and M. P. Weatherrill, Handbook of Grid Generation. Boca Raton: CRC Press, 1998.

3. V. D. Liseikin, Grid Generation Methods. Berlin: Springer-Verlag, 1999.

KEYWORDS: Mesh; Grid; Full-wave; Asymptotic; Computational Electromagnetics (CEM); Computer-aided Design (CAD)

N08-122 TITLE: Advanced Intelligent Web-Based Options to Acquire and Analyze Aircraft Health and Test Data

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PMA-231 - E-2 Hawkeye; ACAT I

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OBJECTIVE: Develop advanced intelligent options to acquire and analyze flight test data, analytic data, aircraft health and maintenance data, and provide innovative options to interface with available supply, logistics, and military flight operations quality assurance data.

DESCRIPTION: The aircraft health status is extremely important in successfully accomplishing both flight test and operational missions and can be evaluated in many ways in both flight and non-flight conditions. Flight test and related analytic data are required to support both land and ship-based testing and advanced mission analysis. The large amount of aircraft health data, the various sources of maintenance, test and analytic data, and different data formats present a challenge to maintenance and flight test personnel. Many limited data options exist that focus on specific areas related to aircraft flight testing and maintenance that provide little or no assistance to flight test team members working on in-service or out-of-production aircraft. The test aircraft may have several hundred instrumentation parameters that sample data at high frequencies. Low frequency data may be obtained from internal aircraft systems and health data from health and usage monitoring equipment. Analytic models used to support flight testing may generate considerable amounts of computational fluid dynamics data and advanced aerodynamic data. Classical flight testing involves extensive flight test planning, instrumentation, testing, analysis, and reporting. It is important to develop advanced intelligent options to acquire and analyze flight test data, analytic data, aircraft health and maintenance data, and provide innovative options to interface with available supply, logistics, and military flight operations quality assurance data.

PHASE I: Demonstrate the feasibility of developing advanced options to acquire and analyze aircraft health, flight test, and related analytic data. Evaluate existing aircraft health systems, maintenance data options, flight test data systems, and related supply and logistics data options. Review innovative options available to analyze the aircraft health monitoring data. Commence developing the advanced intelligent options to acquire and analyze flight test data, analytic data, aircraft health and maintenance data.

PHASE II: Develop prototype advanced intelligent options to acquire and analyze aircraft health data, test data, and related analytic support data. Demonstrate how the innovative options can be interfaced with existing maintenance data options and related supply, logistics, and flight test data using innovative techniques. Show how the vehicle limits could be integrated with an innovative flight test data system. Develop advanced analytic tools to compare flight and maintenance deficiencies and determine any out-of-tolerance conditions. Show how the advanced intelligent options can be used to transfer data to maintenance control computers and flight test data to the test team members' personal computers. Demonstrate the innovative options capability to support the military flight operations quality assurance process.

PHASE III: Extend the innovative options to acquire and analyze aircraft health and test data capability to telemeter the information from the aircraft to select personnel computers. Demonstrate application of the advanced intelligent options support to specific Army and Air Force aircraft acquisition programs. Show how the technology could also be applied to commercial aircraft applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Compare the military flight operations quality assurance process to the commercial flight operations quality assurance process with the FAA, aircraft contractors, and any activity performing commercial vehicle or equipment testing at remote sites.

REFERENCES:
1. OSD memorandum subject: MFOQA Process Implementation of 11Oct 2005

2. Avionics Magazine, Military FOQA Next Step in Safety, 14 Feb 2007

3. Dousis, Dimitri, V-22 Visualization Toolset (VDVT) Implementation, IEEE Aeroapace Conference, Big Sky, MT, 3-10 Mar 2007

4. Anon, Track 11.0, Diagnostics, Prognostics, and Health Management, IEEE Aerospace Conference, Big Sky, MT

5. Carico, Dean, Intelligent Aircraft/Ship Data Analysis Options: A Systems Approach, NDIA, 8th Annual Systems Engineering Conference, San Diego, CA, 24-27 Oct 2005

6. Coble, Keith, Drowning in Data, Starving for Knowledge, OMEGA Data Environment, A White Paper on Securing Meaningful Access to the Information Stored in Our Vast Data Warehouse, http://wylelabs.com/services/telemetryanddatasystems/whp/omegde.hmtl

KEYWORDS: aircraft; flight test; aircraft maintenance; aircraft health; MFOQA; analytic models

N08-123 TITLE: Automated Characterization of Communications, Electronic Attack, Radar, and Navigation Systems

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-265 - F-18 Super Hornet Strike Fighter; ACAT I; PMA-290

OBJECTIVE: Develop technology to automatically and non-invasively extract performance parameters and characterize subsystem components of transmitters and receivers while minimizing human interaction in order to greatly reduce the amount of time necessary to develop analytic models for electromagnetic interference and electronic attack applications.

DESCRIPTION: An increasing number of RF (radio frequency) systems are being installed on Navy aircraft for a variety of applications (e.g., communications, electronic attack, radar, and navigation). A single RF system can operate across literally thousands of channels employing a variety of modulation schemes and modalities. Additionally, a wide variety of architectures are employed in military systems — ranging from traditional super-heterodyne to double up-conversion and direct conversion.

Analysis tools exist that predict electromagnetic interference (EMI) between RF systems and vulnerabilities of such systems to electronic warfare (EW). However, these tools rely upon the user to provide either circuit level models or measured/engineering data as input for the particular RF system and subsystem components. Often, an analyst needs to perform both fast, high-level simulations as well as longer, detailed simulations for a single RF system -- depending upon the amount of time available for the simulation and the fidelity of the results required. Vendors typically do not provide detailed circuit models or measured data for characterizing RF system performance. As a result, analysts often must use engineering judgment to develop their own models or perform system level measurements. Performing measurements for both transmitters and receivers is a process that requires an in depth knowledge of RF system architectures and measurement techniques. Manually performing measurements for the various channels and operating modes for a single RF system can take an exorbitant amount of time.

Automated measurement techniques for extracting RF system performance characteristics at both low- and high-fidelity are needed. For low-fidelity models, the power spectrum (emitters) and receiver sensitivity (receivers) should be characterized through measurements. For high-fidelity models, measurements should provide data sufficient to reverse engineer RF system architectures such that circuit level models can be reconstructed.

PHASE I: Develop a detailed description of the techniques required to characterize both transmitters and receivers through measurement techniques. These techniques should address both low-fidelity and high-fidelity models suitable for frequency-domain and time-domain analysis codes. Additionally, the techniques should be applicable to characterizing all RF system architectures employed by the Navy. Perform manual testing of sample RF systems to validate proposed techniques. Develop plans for automating measurement techniques through custom software and hardware to be implemented during the Phase II effort.

PHASE II: Develop and demonstrate the automated measurement techniques using custom software and hardware to be delivered to the Navy. The automated measurement system should include a user interface for setting up a data collection (e.g., type of measurement, background information for the RF system under test, etc.) as well as providing feedback to the user as the test is being conducted (e.g., warning messages if the user has specified an erroneous test setting). Perform extensive testing of the measurement system including testing on canonical circuits representing typical RF system architectures.

PHASE III: Develop and transition an application suitable for use in evaluating a wide variety of commercial and military systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic has direct utility to a wide variety of commercial and military electronic EMC and EMI problems.

REFERENCES:
1. R. Turlington, Behavioral modeling of nonlinear RF and microwave devices, Artech House Publishers, 1999.

2. P. Crama and J. Schoukens, "Wiener-Hammerstein system estimator initialisation using a random multisine excitation," 58th Automated RF Techniques Group Conf. Digest, Nov. 2001.

3. H. Ku, M. D. McKinley, J. S. Kenney, "Extraction of accurate behavioral models for power amplifiers with memory effects using two-tone measurements," 2002 IEEE MTT-S Int. Microwave Symposium Digest, vol. 1, pp. 139-142, June 2002.

KEYWORDS: Automated measurements; transmitter; receiver; RF performance; electronic survivability; electromagnetic interference.

N08-124 TITLE: <u>Antenna Array and Beamformers to Support Ka-Band Brownout Radar Systems</u>

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-261 - CH-53K Heavy Lift Helicopter Program, ACAT I; PMA-275, V-22

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OBJECTIVE: Develop an innovative low-cost antenna array and beamformer for Ka-band radar systems. The sensor system is to support the safe approach and landing during brownout, whiteout, and sea spray as well as improved safety for night and no/low visibility low altitude pilotage.

DESCRIPTION: Rotorcraft routinely operate in brownout conditions during their approach to landing and during take off in desert environments. Snow and sea spray can also produce similar degraded visual environments. The reduction in visibility presents a danger from unseen aircraft maneuvering nearby, uneven terrain, wires and other obstacles. Even in what is considered good visibility conditions, the visual detection of electrical power lines is difficult.

The antenna array and beamformer will be part of a Ka-band radar system being developed concurrently. The target cost and weight of the complete sensor system is $10,000 and ten pounds. The radar will be a non-imaging real-aperture system requiring coverage over 360 degrees in azimuth and variable elevation coverage dependent on range. The array and beamformer will need to support high resolution waveforms over a range extending from approximately 20 ft to 500 ft. The concepts to be considered should take into account variable field-of-view restrictions present on the wide variety of rotorcraft this system will be installed on. Consideration should be given to the design of an antenna array capable of supporting polarimetric detection algorithms as well as interferometric processing. Initial estimates indicated that an azimuth beamwidth of 5 to 10 degrees will be required. Multiple elevation beams may be needed in order to provide detection of near/far and above/below hazards.

PHASE I: Present in detail, novel designs for a low-cost and light-weight Ka-band array and beamformer assembly suitable for use with a brownout radar system. The analysis supporting each design should consider tradeoffs between cost, weight and performance. Aperture placement, number of apertures and sub-apertures should be explored. The additional complexity required to support polarimetric and/or interferometric operation should be included in the tradeoffs. Analyze the design in sufficient detail to support a down selection to the most promising option at the end of phase I.

PHASE II: Complete the detailed design of the beamformer and antenna array chosen by NAVAIR in Phase I. Design the beamformer to interface with the radar system. Produce a prototype beamformer and antenna array suitable for demonstration of all key performance parameters. Develop a manufacturing plan of sufficient detail to assess system production cost and weight.

PHASE III: Develop a plan and proceed with system production either alone or in partnership with another company.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The sensor system developed will find widespread military and private sector use as a rotorcraft sensor. The sensor could be used by helicopters in the medical and new industries to aid in trying to land in adverse weather conditions with no or low visibility.

REFERENCES:
1. B. M. Keel and C. D. Bailey, “Electronic Bumper Trade Study, GTRI Contributions, Executive Summary” Technical Memorandum GTRI Project D5205.1.0.0.0, 31 Oct 2007.

2. Park, M. “Millimeter-Wave Polarimetric Radar Sensor for Detection of Power Lines in Strong Clutter Background” PhD Dissertation, University of Michigan, 2003.

3. http://www.darpa.mil/sto/solicitations/BAA06-45/index.html.

4. D. Nolan-Proxmire, M. Mewhinney "New Collision Avoidance System Helps Helicopter Pilots". NASA. December, 1996.

KEYWORDS: Brownout; RF sensors; Antenna Array; Array Beamformer; Radar; Cable Detection.

N08-125 TITLE: Automated Maximum Density Analysis Tool for Spot Factor Generation

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles

ACQUISITION PROGRAM: PMA-251 Program Manager for Aircraft Launch and Recovery Equipment

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OBJECTIVE: Develop a tool to automatically generate an aircraft’s spot factor, saving a significant amount of workload over the present manual methods.

DESCRIPTION: The maximum density spot factor, or “spot factor,” is a metric that determines the handling and spotting characteristics of aircraft on carrier flight or hangar decks. It is used as the contractual means to limit the size of new, developmental aircraft. The setting of objective and threshold spot factor requirements is an important aspect of aircraft weapon system contract document preparation, and the review of emerging design concepts against these requirements is a key step in assuring the delivery of ship-compatible aircraft to the Fleet.

The Navy performs this process for several customers. For aircraft programs, we determine the spot factors for new aircraft designs and compare them to contractual requirements. For ship programs, we analyze new ship platform configurations and predict their aircraft handling capabilities. For the Fleet, we utilize the spot factors to predict aircraft complement area requirements and ship platform capabilities.

The current process of generating a spot factor is labor intensive and iterative. Aircraft are packed as tightly as possible into safe parking areas of the ship and then the aircraft are counted. This used to be done with scale plastic templates and a table; currently a computer aided design (CAD) package is used. This process is performed iteratively until a maximum number of aircraft is reached. Then a formula is applied to determine the spot factor.

The Navy is seeking a tool that could automatically calculate the spot factor given the aircraft and deck dimensions. This tool will have to perform at least as well as a human subject matter expert; i.e., fit the maximum number of aircraft into safe parking areas.

The tool must generate an AutoCAD 2006 drawing of the maximum density spot using provided ship and aircraft templates.

PHASE I: Design a tool to automatically generate an aircraft's spot factor and determine the feasibility of the proposed approach to achieve maximum density.

PHASE II: Develop prototype software to be hosted on a Windows/Navy compatible computer. Demonstrate the ability of the software to perform at least as well as a subject matter expert.

PHASE III: Produce production versions of the software. Provide user documentation as well as editors to input any new aircraft or decks.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS:
This topic will benefit any manufacturing process that needs to maximize the amount of usable material and minimize waste; e.g., stamping out metal components from sheet metal for tool fabrication or making clothing from swathes of fabric.

KEYWORDS: Aircraft Spot Factor; Maximum Density Spot; Pattern Optimization; Artificial Intelligence; Carrier Flight Decks; Carrier Hangar Decks.

N08-126 TITLE: Sensor Fusion and Display for Degraded Visual Environment (DVE)

TECHNOLOGY AREAS: Air Platform, Electronics, Human Systems

ACQUISITION PROGRAM: PMA-261, CH-53 Heavy Lift Helicopter, ACAT I; PMA-275, V-22

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OBJECTIVE: Develop a real-time rotorcraft display that depicts a landing site area using fused sensor data while an aircraft approaches and descends in a landing zone.

DESCRIPTION: Since the Gulf War in 1990-1991, there have been many rotary aircraft involved in accidents stemming from brown-out conditions. During brown-out, the aircraft's rotary wind stirs up sand and dust in the down thrust which causes an in-flight visibility restriction resulting in the pilot being unable to see nearby objects which provide the outside visual references necessary to control the aircraft near the ground. The resultant spatial disorientation and loss of situational awareness has led to fatalities and loss of aircraft.

The focus of this effort will be to explore innovative sensor fusion technologies and develop novel display presentation techniques that best transmits critical sensor information to the pilot and crew during an approach to the landing zone. The displays should provide drift cues, topography maps, and obstacle avoidance capabilities. In particular, fuse symbolic aircraft state information over terrain/obstacle imagery generated from sources such as:

a.) Synthetic terrain from a persistent terrain/obstacle elevation database built up by 3D sensors such as RADAR or LIDAR.
b.) Terrain/obstacle image from a 2D imaging sensor that can see through dust, such as imaging radar or passive mmWave sensor.

The display technology should take into account multi-sensor cues and onboard sensors. Automating these technologies will help to reduce pilot workload and minimize the processing time required to send critical information in near real-time using current on-board mission computer systems.

PHASE I: Demonstrate proof of concept of appropriate processing and/or display technologies that can be used or enhanced for the depiction of a landing site area. The display should integrate drift/obstacle cues, flight instruments, terrain elevation data and/or symbology to provide accurate sensor data to the pilot and crew during approach and decent of the rotorcraft.

PHASE II: Using modeling and simulation, design and develop a panel mounted display prototype that automates the fusing of sensor data and displays in near real-time a depiction of the landing area and rotorcraft dynamic flight situation during approach and landing. Simulate the sensors being used such as 3D scanning and 2D imaging. Also simulate the terrain/obstacle sensor's scan pattern, limited scan rate, limited field-of-regard and limited resolution if applicable.

PHASE III: Design and develop a complete system that demonstrates the above-mentioned objectives and performance criterion. Conduct flight tests in degraded visual environments to characterize the system performance while adhering to the safety standards for military rotorcraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This type of technology can be used to aid commercial/private aircraft during adverse weather conditions. Situational awareness is an issue for both military and commercial pilots.

REFERENCES:
1. William J. Sharp Air Force Office of Scientific Research Public Affairs (October 2001). National Helicopter Experts Gather to Discuss Aerodynamic Solutions for Brownout. http://www.afosr.af.mil/News/nr_2007_03_helicopterExperts.htm.

2. Anderson, Major Lee, 'Solutions for Helicopter Brown-out'. http://www.afit.edu/cse/docs/presentations/NDIA%20SE%2006%20-%20ZeroVis_Brief.pdf.

3. Munitions Directorate, AFRL/MN 'AFRL Develops Partial Solution to Helicopter Brownout'. http://www.wpafb.af.mil/news/story.asp?id=123066184.

KEYWORDS: Brownout; Whiteout; Situational Awareness; Degraded Visual Environment (DVE); Rotorcraft; Displays.

N08-127 TITLE: Non-Contact Cure State Measurement

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop the capability to measure the state of cure of a recently applied coating (epoxy or urethane), sealant (polythioether or polysulfide), or adhesive (epoxy, acrylic, urethane) without contacting the product's surface. Indicate an appropriate time when further layers of the same material or other operations (i.e., primer, paint, thermal or chemical processing, etc.) can proceed on the applied product.

DESCRIPTION: Manufacturing processes are typically delayed from several minutes to several hours while coatings, sealants, and adhesives sufficiently cure to allow subsequent operations. Local environmental conditions can accelerate or decelerate cure depending on the chemistry of the materials, which makes degree of cure a variable over time and ultimately results in built-in down-time to assure sufficient cure is achieved. A technology for determining the relative state of cure for a variety of known coatings, sealants, and adhesives, without compromising the integrity of the applied material, would be a manufacturing enhancement and production time reduction factor. The technology must ultimately be able to accommodate slight variations of chemistry within the chemical classes such as exist among different vendors or due to effects of various fillers and must be measured on substrates consistent with aircraft manufacture.

PHASE I: Develop a design concept for an innovative measurement technology that meets the objective. Develop a protocol for defining the state of cure for each application category (coating, sealant, adhesive). Demonstrate the proposed approach on the coatings, sealants, and adhesive materials listed in the objective.

PHASE II: Build and demonstrate prototype, portable hardware capable of measuring the relative state of cure of the materials listed in the objective. Demonstrate that the technology is able to accommodate slight variations of chemistry within the classes. Develop a protocol for measuring state of cure for new materials within chemical classes.

PHASE III: Deliver hardware capable of meeting the stated objective for use by the sponsoring program and other interested DOD platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Both military and commercial aircraft manufacturers, as well as those in the automotive or related industries, should realize a benefit by being able to measure the state of cure of coatings, sealants, and adhesives within a variety of chemistries, thereby enabling a reduction in the overall processing time for their respective products.

REFERENCES:

1. Urethane coating---Mil-PRF-85582, AMS-C-27725.

2. Polysulfide sealant---AMS 3281.

3. Polythioether sealant---AMS 3277.

4. Epoxy adhesive---MMM-A-132 (i.e. EA9394NA).

KEYWORDS: Non-Contact Cure; Measurement; Coatings; Sealants; Adhesives; Urethane.

N08-128 TITLE: Alternative Material for Aluminum-Beryllium Alloys in Military Aerospace Applications

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

OBJECTIVE: Develop and demonstrate innovative, low-cost material alternatives to aluminum-beryllium in military aerospace applications.

DESCRIPTION: Aluminum-beryllium materials are widely used in military aerospace applications because of their low density, high stiffness, and high high-temperature resistance characteristics. However, processing of these materials involves health risks to personnel. Current requirements for reductions in exposure levels for beryllium (Be) have been specified by the Occupational Safety and Health Administration (OSHA) (regulatory requirement) and the American Conference of Governmental Industrial Hygienists (ACGIH) (consensus guide). There is therefore a need for innovative approaches for alternative materials as replacements for aluminum-beryllium.

PHASE I: Develop a low-cost approach for an alternative to aluminum-beryllium in low-density, high-stiffness, high-temperature applications.

PHASE II: Fully develop the concept demonstrated under Phase I through a material process specification and demonstration of material reproducibility. Perform testing and property comparisons with AlBeMet 162H, Beryllium SF-220-H, and Beryllium I-70-H. Demonstrate that the developed alloys are compatible with other aircraft system materials such as aluminum, titanium, SAE AMS 3281 sealants, primers, and topcoats.

PHASE III: Fully develop the required material allowables. Transition the developed material to JSF and other low density, high stiffness and high temperature aerospace applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: All current military aircraft utilize aluminum-beryllium alloys in many different applications. Subsequently, all of these aircraft platforms face the same concerns with respect to beryllium. In addition, commercial manufacturing or repair facilities could realize significant cost savings by utilizing less occupationally hazardous materials.

REFERENCES:
1. Federal Register, Vol. 67, No. 228, of 26 Nov 02. OSHA "Occupational Exposure to Beryllium," Request for Information.

2. ACGIH, 2003 TLVs® and BEIs®, "Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices," Notice of Intended Changes.

3. Critical properties of Be-Al alloy for optics applications in aerospace dated 8 January 2008.

KEYWORDS: Beryllium; Aluminum-Beryllium; Magnesium; Anodize; Salt-Fog; Beryllium Dust.

N08-129 TITLE: Ionic Channel Amplifier Matrix Sensor

TECHNOLOGY AREAS: Biomedical, Sensors

ACQUISITION PROGRAM: PMA-264 - Air ASW Systems

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop an innovative Micro-Electro-Mechanical Systems (MEMS) Ionic Channel Amplifier technology to measure the electromagnetic spectrum from DC to 100Hz emulating the Ampullae of Lorezini.

DESCRIPTION: The current state-of-the-art silver/silver-chloride electrodes are not robust enough nor are they mass producible for the intended underwater detection application envisioned. An ionic channel amplifier, similar in performance to those found in sharks, capable of measuring EM fields which gives them the ability to detect stationary and moving underwater objects, is the goal. New technologies are sought to provide the capability to improve quick response target detection and localization in dangerous, sub surface, high current environments locating hostile objects or vehicles. The ability to emulate the elasmobranch sensory methodology in MEMS could provide direct measurement of DC fields in the fluids.

Innovative sensor technologies are sought that duplicate the shark's Ampullae of Lorezini and are capable of collecting, processing, transmitting and displaying the measured information. This should include the development and integration of advanced electronics coupled with innovative materials, electronics, and processing technology in a very small self contained deployable package. The technical challenges to consider are: Detection Spectrum (dc to 100 Hz); Measure ambient fields; Dynamic ranging, self calibration; and for the Deployable Package (basic capability); MEMS package location determination; Submersible in salt water to 300 meters; Transmit/Receive instruction and data (real-time); and An array configuration and matrix (maximize signal gain).

PHASE I: Perform design and analysis of the proposed ionic channel amplifier in MEMS package size. Define its performance characteristics (including, but not limited to, spatial resolution, spectral resolution, spectral coverage, speed of operation, data transfer requirements, and power consumption), develop the associated component level electronic circuits, and select the major components for proving the feasibility of the proposed system. Analyze all possible failure mechanisms and estimate sensor reliability, based on the performance of the electrical and mechanical subsystems.
Establish feasibility through limited lab concept demonstration verifying subcomponents and design.

PHASE II: Design and develop a full-scale prototype ionic amplifier ready to conduct a seawater-based demonstration to show that it will be able to perform according to the Phase 1 design.

PHASE III: Transition technology to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: To the MEMS Ionic Channel Amplifier could enable medical diagnosis, remote security monitoring of facilities and vital infrastructure assets.

REFERENCES:
1. Bullock, T. H. 2005. Electroreception. ISBN 0387231927.

2. Kalmijn, A. J. 1966. Electro-perception in sharks and rays. Nature 212:1232-33.

3. Kalmijn, A. J. 1971. The Electric Sense of sharks and rays. Journal of Experimental Biology. 55:371-83.

4. G.R. Broun and V.I. Govardovskii. Electrical model of the electroreceptor of the Ampulla of Lorenzini. Neurophysiology, 0090-2977 (print), Volume 15, Number 3 / May, 1983 http://www.springerlink.com/content/lm38302873761751/.

KEYWORDS: Sensors; Micro Electro-Mechanical Systems; Signal Processing; Biology; Electromagnetic.

N08-130 TITLE: Pulse Power Electrical Energy Storage Device

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles, Electronics, Space Platforms, Weapons

ACQUISITION PROGRAM: PMA-265 - F/A-18 E/F Hornet, ACAT I; F-35 - Joint Strike Fighter, ACAT I

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OBJECTIVE: Develop a pulse power energy storage device for use on tactical aircrafts.

DESCRIPTION: The Navy has various programs and proposed upgrades (JSF, F/A-18E/F/G) that hold high promise in providing revolutionary gains in warfighting capability. These programs will place extraordinary demands on electrical power and energy storage devices. Innovative research is required to develop a 1-2 volt, 5-l0 KW/KG high-energy density energy storage device. The discharge should be linear between 500-1000 amps for 1-5 seconds. In addition, it should have a 20C-100C charge rate, operate in an aircraft environment specified in MIL-STD-810 including temperature range from -40C to +71C, altitude to 65,000 feet and carrier based high vibration and G loads. The cycle life should be greater than 10,000 charge-discharge operations.

PHASE I: Define and design pulse power energy storage device with the ability to meet or exceed the proposed characteristics.

PHASE II: Design, develop, and demonstrate the pulse power energy storage device. Demonstrate discharge and charging rates of the device.

PHASE III: Support packaging and deployment of the pulse power energy storage device to the aircraft platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The pulse power energy storage device can be utilized by multiple commercial users. Applications include starting trucks and automobiles, fuel cell system power regulation, and use in electric cars to limit the breaking regenerative effects.

REFERENCES:
1. http://www.maxwell.com/ultracapacitors/technical-support/index.asp.

2. https://www.koldban.com/SearchResults.asp?Cat=4.

KEYWORDS: Pulse Power; Energy Storage Device: Aircraft Power; Electrical Power.

N08-131 TITLE: Innovative Approaches for the Flaw-Tolerant Design and Certification of Airframe Components

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: H-1, H-53, H-60

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a reliable predictive capability for the evaluation of flaw tolerance in expected life of metal and composite airframe components, given part specifications, material properties, initial flaws, such as voids, inclusions, heterogeneous grain structure and design load spectra.

DESCRIPTION: During the early 70's the Air Force moved to adopt the concept of damage tolerance based on the concepts and methods of linear elastic fracture mechanics (LEFM) for airframe design and fleet management. While this methodology has not been adopted by other services, methods based on fracture mechanics are routinely used as secondary design criteria and fleet management in the case of aged aircraft where cracks are known to be present. The disadvantage of damage tolerance methods based on LEFM is that unrealistic assumptions regarding initial cracks have to be made. Methodology for life prediction that relies on realistic representations of the nature and distribution of initial flaws in as manufactured airframe components would be of great benefit. Recent developments in numerical simulation technology, that support verification and validation procedures and multi-scale modeling, provide the necessary means for evaluating alternative failure initiation models capable of accounting for initial flaws. Over the last four years NAVAIR has been engaged in a program to develop analytical tools to characterize the corrosion fatigue process. This program has made substantial progress and has developed a number of features that would be required to support a flaw tolerance analytical tool. The goal is to extend the results of the corrosion fatigue program and develop an analytical tool that can be incorporated in a stress analysis program which has the capability to verify the accuracy of the numerical solution and the quality of the mathematical model.

PHASE I: Determine the feasibility of developing an algorithmic structure designed to meet the objectives enumerated above and development of an implementation plan. Existing software tools and processes will be utilized to the maximum extent possible. The implementation plan will include a detailed justification of the choice of software tools and the technical requirements for modifications and enhancements.

PHASE II: Design, develop, implement and test the algorithms developed. A parametric family of models that address the specific technological features of airframe components in detail and include crack nucleation analysis may be implemented. The implementation should include provisions for the integration with Product Lifecycle Management (PLM) systems employed by aerospace OEMS. At least three model problems that demonstrate the key features of the implementation will be solved and documented.

PHASE III: Transition the technology to the Program Offices and the airframe manufacturers.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The private-sector market for the software tool developed under this project will be the commercial divisions of aerospace OEMs and their suppliers. Substantial market opportunities exist in the automotive and shipbuilding sectors as well.

REFERENCES:
1. ASME V&V 10-2006. Guide for Verification and Validation in Computational Solid Mechanics. An American National Standard. The American Society of Mechanical Engineers, 2006.

2. P. J. Roach. Verification and Validation in Computational Science and Engineering. Hermosa Publishing, Albuquerque, 1998.

3. C. R. Cook and J. C. Glaser. Military Airframe Acquisition Costs: The Effects of Lean Manufacturing. Rand Report MR-1325-AF 2001 (ISBN: 0-8330-3023-X).

4. R. Martin and D. Evans, Reducing Costs in Aircraft: The Metals Affordability Initiative Consortium, JOM, 52 (3) (2000), pp. 24-28.

KEYWORDS: Certification; Flaw Tolerance; Corrosion; Fatigue; Analysis; Lifecycle Management.

N08-132 TITLE: Improved Analysis Techniques for Prediction of Avionics Electromagnetic Interference and Vulnerability

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-231 - E-2 Hawkeye, ACAT I; PMA-290 - Multi-Mission Aircraft

OBJECTIVE: Make significant innovative improvements to physics-based electromagnetic interference and vulnerability tools by incorporating system performance parameters and characterizations of subsystem components within aircraft transmitters and receivers.

DESCRIPTION: The goal of physics-based electromagnetic interference (EMI) and vulnerability tools is to allow analysts to accurately predict RF (radio frequency) system level performance in the presence of electromagnetic signals originating from other avionics on the aircraft, high-power transmitters on other aircraft or ships, or even from microwave weapons. To enable accurate predictions the incorporation of field-circuit interaction computational engines and multi-physics simulations linked to model libraries need to be developed and experimentally validated. The model libraries should be capable of using experimentally extracted data when available in addition to idealized responses. For example, models should be developed that enable more realistic filter responses to be used such as bandpass filters with spurious passbands. Native signal analysis should be developed to operate directly on the transient data generated from transient simulations. A validation process is to be performed in parallel with the analysis tool enhancements. The goal of this effort is to develop a robust and accurate tool through comparisons with real world measurements. Initial testing activities should focus on canonical problems that are well defined and controlled. Later the validation should focus on data collected from operational platforms. Experimental validation should be used to refine the specific nature of the performance parameters and characterization to be used.

PHASE I: Develop a detailed description of the nature of, and information requirements for, the field-circuit interaction computational engines and multi-physics simulators to be interfaced with the analysis tool. Consideration should be given to how the overall prediction accuracy degrades as the as a function of the level of detail associated model library. Validation is to be done on a variety of canonical problems and limited number of real-world problems.

PHASE II: Develop and demonstrate the field-circuit interaction computational engines and multi-physics simulators to be delivered to the Navy. Conduct an extensive experimental validation using canonical circuits representing typical RF system architectures and real-world systems. Lessons learned from the validation should be fed back into the analysis tool.

PHASE III: Deliver the analysis tool and thorough documentation to the Navy and provide on-site training. Develop a commercial application suitable for use in evaluating a wide variety of commercial and military systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic has direct utility to a wide variety of commercial and military electronic EMC and EMI problems.

REFERENCES:

1. R. Turlington, Behavioral modeling of nonlinear RF and microwave devices, Artech House Publishers, 1999.

2. P. Crama and J. Schoukens, "Wiener-Hammerstein system estimator initialisation using a random multisine excitation," 58th Automated RF Techniques Group Conf. Digest, Nov. 2001

3. H. Ku, M. D. McKinley, J. S. Kenney, "Extraction of accurate behavioral models for power amplifiers with memory effects using two-tone measurements," 2002 IEEE MTT-S Int. Microwave Symposium Digest, vol. 1, pp. 139-142, June 2002.
KEYWORDS: EMI Coupling; Transmitter; Receiver; RF Performance; Electronic Survivability; Electromagnetic Interference

N08-133 TITLE: <u>Synergistic Composite Design Data Approaches to Support both Propulsion and Airframe Applications</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: PEO JSF - Joint Strike Fighter; ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop innovative methods and analyses that can support both the propulsion and airframe communities' use of organic matrix composites with a single test data set. Experimentally and analytically derived solutions are sought.

DESCRIPTION: The generation of organic matrix composite databases necessary to design aircraft structural and propulsion systems has traditionally been a time consuming, expensive endeavor. Furthermore, it has not been possible to develop a single design database that supports the needs of both propulsion systems and airframe structures. This results from the use of disparate approaches to the generation of composite design. Traditionally, propulsion design organizations have used un-notched A-basis design values and airframe design organizations have used notched B-basis allowables. Over time, methods and test matrices tailored to each application have evolved along divergent paths, resulting in data sets that are not translatable from airframe application to propulsion application, and vice versa. In recent years, structural use temperatures on military aircraft have increased, leading to the design of an organic matrix composite structure that operates in the 400-500°F range. This moderate temperature overlap with the needs of propulsion design presents an opportunity to develop and demonstrate methods, approaches and data sets that can satisfy both interests, while reducing the time and cost burden for overall air system design.

PHASE I: Develop and demonstrate methods and approaches for the generation of design data that can be utilized by both the propulsion and airframe communities.

PHASE II: Develop the design property values and corresponding data analysis to verify the approach.

PHASE III: Fully validate methodology and implement on material systems for transition to the F-35.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The use of high temperature capable polymeric materials for structural and propulsion applications continues to grow in civil aerospace, as in the military sector. The methods developed in this work will reduce the cost of dual use development technology in a fashion similar to the overall goals of the program.

REFERENCES:
1. U.S. Department of Defense, Composite Materials Handbook, Volume 1, Technomic Publishing Company, Inc. 488 (1999).

2. http://www.compositesworld.com/hpc/issues/2003/May/100.

3. http://www.grc.nasa.gov/WWW/RT2002/5000/5150sutter.html.

4. http://www.sti.nasa.gov/tto/Spinoff2006/ip_4.html.

5. U.S. Pat. 3,745,148 (July 10, 1973) T. Serafini, P. Delvigs, R. Lightsey, (to The United States of America as represented by the Administrator of the National Aeronautics and Space Administration).

6. U. S. Pat. 4,560,742 (December 24, 1985) R. H. Pater (to The United States of America as represented by the Administrator of the National Aeronautics and Space Administration).

7. U. S. Pat. 5,322,924 (June 21, 1994) C. K. Chuang (to The United States of America as represented by the Administrator of the National Aeronautics and Space Administration).

8. U. S. Pat.5,760,168 (June 2, 1998) P. M. Hergenrother, J. G. Smith (to The United States of America as represented by the Administrator of the National Aeronautics and Space Administration).

9. Salin, I.M. and Seferis, J.C., “Anisotropic Degradation of Polymeric Composites: From Neat Resin to Composite,” 17, (3), 430 (1996).

10. Bowles, K.J.; McCorkle, L.; Ingrahm, L., "Comparison of Graphite Fabric Reinforced PMR-15 and Avimid N Composites After Long Term Isothermal Aging at Various Temperatures," NASA TM-107529, 1998.

KEYWORDS: Composite; High Temperature; Analysis; Failure Criteria; Propulsion; Airframe.

N08-134 TITLE: Edge Bonding of Infrared Windows

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: Navy Unmanned Combat Air System (N-UCAS); ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop edge bonding technology to make large, strong windows out of smaller plates of spinel, aluminum oxynitride (ALON), or sapphire.

DESCRIPTION: The ultimate size of infrared windows is presently limited by the size of available hot isostatic pressing equipment for spinel and ALON, and by crystal growing equipment used to make sapphire plates. Larger windows for future systems could be fabricated from available plates if strong, thin bonds can be made between plates along their edges. Ideally, the bond line should be as strong as the window material and transparent to infrared and visible radiation to the same degree as the window material. The bond line should be as thin as possible and, ideally, transmit over the same range of infrared and visible wavelengths as the window material. Transparency of the bond line is not a requirement, but it is highly desirable. Strength is a requirement.

PHASE I: Demonstrate a method of edge bonding spinel or ALON or sapphire coupons to achieve a flexure strength comparable to that of the window material. Demonstrate the strength and transparency of the bond using bonded, polished, test specimens.

PHASE II: Demonstrate the flexure strength of the bond with optically polished equibiaxial flexure disks. Design a method capable of implementing the bonding process on large windows. Fabricate a 76 x 76 x 2 cm flat window blank by edge bonding two or four panes. After bonding, demonstrate that the blank is capable of withstanding grinding and polishing and will allow visual and microscopic inspection of the bond line.

PHASE III: Transition the technology to a Navy airborne system or a Navy ship such as the DDX.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Although the technology is primarily of military value, large, bullet-proof windows for commercial vehicles could be fabricated by the bonding technology developed under this topic.

REFERENCES:
1. Gentilman, R.; McGuire, P.; Fiore, D.; Ostreicher, K.; and Askinazi, J., "Large-Area Sapphire Windows," Proceedings of SPIE. 2003, 5078, 54-60.

KEYWORDS: Ceramic Bonding; Ceramic Joining; Infrared Window; Spinel; Aluminum Oxynitride (ALON); Sapphire.

N08-135 TITLE: Innovative Low-cost, In-situ Consolidation Head for Complex Geometry Thermoplastic Fiber Placement

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: PMA-261 - CH53K Heavy Lift Helicopter, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop and demonstrate a Thermoplastic Fiber Placement Head that is capable of managing, cutting and adding individual tows over complex contours.

DESCRIPTION: Structures such as the lower cabin and ramp skins of rotorcraft are candidates for the application of thermoplastics due to their inherent toughness. However the cost of producing structures with these materials remains a barrier to implementation. A process that combines both automation for placement of the material and simultaneous cure of the material offers promise in addressing the affordability of using thermoplastics for rotorcraft structure. Current thermoplastic fiber placement systems are limited to simple geometries with gentle contours. Furthermore, many of the systems lack the ability to manage individual tows of material which is required to fabricate more optimized complex parts with intricate ply details. This project will develop, integrate and demonstrate all of the technologies required to produce an in-situ thermoplastic fiber placement head that can be used to fabricate complex contour parts with intricate ply details. The system must be multi-tow (single tow/band placement systems are not of interest in this project) and be conformable. The ability of the system to produce laminate quality near that of autoclave consolidation processing must be verified through coupon testing. The resultant product must be capable of producing thermoplastic parts that can meet the weight, cost, and quality objectives of the acquisition programs.

PHASE I: Determine the feasibility of developing the desired fiber placement head concept. Determine the major technical challenges of the system shall be identified and risk mitigation plans produced accordingly. Preliminary drawings of the fiber placement head should be developed.

PHASE II: Mature the concept defined in Phase I. Design and construct a prototype fiber placement head. Fabricate representative complex contoured structural elements. Conduct coupon testing and first article cut up testing of the elements produced to assure laminate quality and integrity.

PHASE III: Transition the successfully developed technology to the fleet. The approaches, materials and processes developed should be readily applicable to commercial aerospace platforms where future platforms are seeking to utilize greater amounts of composite materials in a more affordable manner.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The approaches, materials and processes developed should be readily applicable to commercial aerospace platforms where future platforms are seeking to utilize greater amounts of composite materials in a more affordable manner.

REFERENCES:
1. Lamontia, M.A., M.B. Gruber, “Remaining Developments Required for Commercializing In situ Thermoplastic ATP”; SAMPE 2007, Baltimore MD, June 3-7, 2007. http://www.accudyne.com/SAMPE2007A.pdf.

2. Lamontia, M.A., M.B. Gruber, “Limitations on Mechanical Properties in Thermoplastic Laminates Fabricated by Two Processes: Automated Thermoplastic Tape Placement and Filament Winding”; 26th SAMPE Europe Conference, Paris France, April 5-7, 2005.

3. Chang, I.Y., Lees, J.K.; "Recent Development in Thermoplastic Composites: A Review of Matrix Systems and Processing Methods"; Journal of Thermoplastic Composite Materials, Vol. 1, No. 3, 277-296 (1988).

KEYWORDS: Thermoplastics; Fiber Placement; In-Situ; Placement Head; Automation; Complex Contour.

N08-136 TITLE: Advanced Cable for Arresting Aircraft

TECHNOLOGY AREAS: Air Platform, Ground/Sea Vehicles

ACQUISITION PROGRAM: PMA 251, Aircraft Launch and Recovery Equipment

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop an advanced cable for arresting aircraft aboard carriers with an improved operational life over the current cable.

DESCRIPTION: The Navy uses wire rope as the means of arresting aircraft aboard aircraft carriers. A length of wire rope (called the cross-deck pendant) is spanned across the recovery area on the flight deck and attached to another length of wire rope (called the purchase cable) which is reeved on the arresting engine below deck. The arresting hook of the incoming aircraft engages the cross-deck pendant, which pulls the purchase cable initiating the arresting engine stroke. The arresting engine absorbs the kinetic energy of the aircraft, enabling the aircraft to land on the carrier's limited deck space.

Operational life of the purchase cable is currently around 1,400 arrestments. Operational life of the cross-deck pendant is 125 arrestments. The Navy is seeking an improved cable capable of increasing the operational life of the current purchase cable. A secondary desirable criterion is an increased strength-to-weight ratio, which would improve arresting gear performance.

The cable will be subject to the issues associated with the carrier environment: all weather, wide range of temperatures, aircraft exhaust, abrasion from the tail hook, the sheaves, and non-skid which is applied to the flight deck. The current purchase cable is steel wire rope surrounding a polyester core center, 6 x 31, Lang lay, Warrington Seale Die Formed Strand. Diameter is 1-1/2 inches. It has a minimum breaking strength of 215,000 lbs and a weight of 372 lbs/100 feet. An improved cable must be flexible enough to bend around the aircraft tail hook (3.6-inch radius) and around numerous sheaves without crimping (28- and 33- inch pitch diameters). Cable diameter cannot be increased, since this would present issues with ship integration and aircraft tail-hook dimensions.

PHASE I: Design and develop a cable concept. Determine its feasibility to meet the above criteria including breaking strength, flexibility, weight, and elongation. Consider cost to manufacture.

PHASE II: Develop a full-length prototype of the purchase cables based on the concept(s) analyzed in Phase I. Conduct cycle testing to failure in order to determine operational life.

PHASE III: Produce arresting cables in response to Navy procurement actions.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Cables of this magnitude find numerous applications in the commercial sector, including bridges, mining, amusement parks, ski lifts, ship moorings, and building construction.

REFERENCES:
1. "Wire Rope Users Manual," 4th ed., Wire Rope Technical Board.

KEYWORDS: Cable Construction; Advanced Materials; Breaking Strength; Flexibility; Arresting Hook; Fatigue Life.

N08-137 TITLE: Cure System Equipment Optimization for Rapid Cure Epoxy Coated Fiberglass

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Joint Strike Fighter Program Office, Airframe IPT, ACAT I D Program

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a cost-effective curing system (hardware) for a very rapid curing resin pre preg system for galvanic barrier ply restoration on complex pre-cured and machined carbon composite parts. The complete system is to be based on proven epoxy chemistry resins for barrier ply applications with type "E" 108 style fiberglass cloth.

DESCRIPTION: New developments in rapid cure resin systems have overcome limitations of legacy properties associated with these novel resin systems including, but not limited to brittleness, aircraft fluid and environment sensitivity, unpredictable cure, and low glass transition temperature. A rapid cure epoxy based resin has been identified as a prime candidate for the specific application of restoring galvanic barrier ply corrosion protection on pre-cured machined carbon composite surfaces. An objective of this effort will be to develop a very rapid cure system (hardware) that can cost-effectively cure aerospace quality galvanic barrier pre-preg on complex composite parts. The proposed rapid cure system equipment for the co-developed rapid cure epoxy resin pre-preg must demonstrate a minimum glass transition temperature of 375F and resistance to standard DoD aircraft fluids and environments. Curing optimization of surrogate materials will not be acceptable. The cure system equipment should provide the required energy necessary to activate the rapid cure epoxy resin, while curing through the 108 fiberglass cloth for all parts with no detriment to the host pre-cured composite part. Cure may take place on a vacuum bagged part to maintain specific cure ply thickness.   The cure system equipment must be able to maintain adequate cure on the complex geometries and sizes of composite parts for DoD fighter aircraft. The system should be either a moving lamp assembly or a fixed lamp system with a conveyer belt for moving the composite parts. A potential for field deployablity should be considered along with the ability to support equipment logistically should upgrades or replacement parts be required. The system should be a fully enclosed assembly with adequate personnel protection for workers in the immediate area of the production environment and comply with applicable Occupational Safety and Health regulations and/or requirements. There are approximately 175+ parts that are available on DoD fighter aircraft.

A cost-effective, low power/energy efficient, robust, portable, upgradeable, reconfigurable, user friendly, cutting edge, safe, etc. system should be considered that does not require any special support equipment beyond that which may be available within a typical aerospace composite manufacturing center. An example may be a LED UV curing system chosen over a traditional bulb-type UV curing mechanism.   Damage/degradation should not be incurred by host pre-cured composite part undergoing galvanic barrier ply restoration.

PHASE I: Demonstrate cure system (hardware equipment) proof-of-concept to deliver sufficient and consistent energy or specific activator over the surface geometry of complex composite parts. It is intended that this cure system will provide all that is required to fully cure the very rapid cure resin pre-preg system. Work with the chemistry formulators to optimize the cure effectiveness to reduce total system costs and significantly reduce cure cycle times.

PHASE II: Design, fabricate, and test a prototype enclosed cure system for composite parts to demonstrate the ability to fully cure the pre-preg. Evaluate staged cures and methods if required for satisfactory composite surface finish and properties. Scaleable consideration may be desired given required focal lengths as well as part size and geometry. No pre- or post-processing of parts should be required beyond this device or apparatus for final finish or material properties.

PHASE III: Modify the system to work with complex geometry surfaces of actual composite parts that have varied size, complexity and base composite resin systems. The system must have the final production environment and limitations in mind during this phase of the program. Provide adequate system description and specifications to effectively transition the technology to the DoD aerospace composite manufacturing facilities.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The commercial aircraft manufacturers and automotive and marine vehicle repair shops will benefit form the technology developed under this effort.

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KEYWORDS: Resin Cure Equipment; Galvanic Barrier Ply Restoration; Robotic Cure System; Manufacturing; Optimized Cure; Quality Assurance.

N08-138 TITLE: Non-Mechanical LADAR for Improving The Helicopter Pilot’s Situational Awareness in Reduced Visual Cue Environments

TECHNOLOGY AREAS: Air Platform, Electronics

ACQUISITION PROGRAM: PMA 261 - CH-53K Heavy Lift Helicopter, ACAT I; PMA-275; PMA-209

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: To advance the state-of-the-art of non-mechanical LADAR for the purpose of developing a near-real-time, light-weight, terrain mapping and obstacle detection capability for helicopters landing in reduced visual cue environments (ie: brown-out, white-out, etc). This SBIR topic is target towards development of an electronically scanned fiber laser array or suitable alternate technology that provides a very high speed laser beam steering capability. Concurrent with this development will be the receiver technology the will accompany the scanned array since they will use the same optics.

DESCRIPTION: Laser based sensors for measuring ground speed (Vg) and height above the ground (AGL) are very attractive for providing to the helicopter pilot, information regarding the aircraft position and drift over the ground in reduced visual cue environments. A laser-based system is currently under development which uses a 1.55 micron pulsed fiber laser, and is class I eye-safe. The system will be light weight and robust with no moving parts and is considered the first step towards a robust landing solution for helicopters. Significant progress has been made in the area of laser phased array technology for non-mechanical laser beam steering. One such technology is a two-dimensional optical beam deflector operated by wavelength tuning. For one dimensional beam steering, the laser beam to be deflected is split into N co-directional sub-beams of equal intensity with the aid of a plane-parallel plate. These sub-beams experience a relative time delay, which translates into a phase difference, thus forming a phased array. This concept has been carried further by to a 2-dimensional array and demonstrated in a lab. Other work has been conducted under the DARPA Steered Agile Beam (STAB) program. To achieve the goal of a light-weight steer-able beam system, they have pursued several candidate component technologies such as micro-electro-mechanical systems (MEMS) structures. In one of the MEMS projects, they are developing an array of actuators that translates a micro-lens array in both orthogonal lateral directions. Another technology under investigation is an electro-statically driven actuator approach which consists of micro-mirrors with novel "twin-crank" actuators that efficiently convert lateral motion into rotational motion in two dimensions. Another technique for steering a beam has been to use a liquid crystal optical phased array which can be fabricated such that the phase change introduced along the array can be electrically controlled. In this fashion, an incident beam sees a varying refractive index as it propagates along the array and is thereby steered. A significant amount of work has been accomplished by AFRL in the area of phased array laser technology, as well, in particular, a system called PAPA which is a phased array of phased arrays.

Although, there has been significant advancement in fiber lasers and non-mechanical agile beam steering, there is much work yet to be done to make this into a practical system that can survive the harsh helicopter environment. The state-of-the-art of electronic fiber laser beam steering needs to be advanced in order to achieve a practical LADAR system suitable for near-real-time terrain mapping. Additionally, the state of fiber laser receiver technology needs significant advancement in order to function with the above mentioned scanning laser. Although a separate aperture for the laser return can be used, in the interest of a simplified compact and light design, it is highly desirable to use the same aperture for coherent transmit and receive functions, To accomplish this, sub-aperture receive techniques need to be developed.

PHASE I: Determine the feasibility of developing a fully functional, near real-time, LADAR system that uses no mechanical moving components and can be used to improve a helicopter pilot’s situational awareness in reduced visual cue environments.

PHASE II: Develop a prototype LADAR that will demonstrate near-real-time imaging and demonstrate a scalable concept that can be further developed into a robust concept demonstrator suitable for installation on helicopters. Performance specifications have not yet been developed, but expect the laser to be class I eye-safe, with a field-of-regard of at least +/- 30 degrees. Image update rate on a suitable display should approach 10 hz, but there can be some relief if it can be shown that the update rate is limited by processing power and/or operating system.

PHASE III: Develop a functional prototype LADAR suitable for installation on a military helicopter. The LADAR system can be a strap-in system with a cockpit mounted display that provides near-real-time imagery of the LZ below the aircraft. Additionally, the system will provided Vg and AGL information that is extracted from the functional prototype LADAR. As in Phase II, the LADAR must be class I eye-safe and the objective display update rate is 10 hz. The system will be demonstrated in actual brown-out conditions at a government selected landing site.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology is applicable to all helicopter operations, both military and civilian. In particular, helicopter operations that require flight in close quarter conditions or reduced visual cue (day or night) environments such as police operations, news agency operations, fire-fighting, off-shore oil platform operations, geological surveys, etc, would benefit significantly with this technology. Additionally, fixed wing commercial operations could benefit from the use of this technology to enhance situational awareness during airport landings in conditions of limited visibility.

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KEYWORDS: LADAR; Optical Phased Array; Brown-out; Laser; Landing Aid; Laser Beam-Steering; Situational Awareness

N08-139 TITLE: Mixed Gas Hypoxia Training in Low Pressure Chambers

TECHNOLOGY AREAS: Air Platform, Biomedical, Human Systems

ACQUISITION PROGRAM: PMA 205: Aviation Survival Training, Aviation Physiology, Aviation Safety

OBJECTIVE: Improve the Safety and Effectiveness of Hypoxia Training in Low Pressure Chambers by Incorporating Mixed Gas

DESCRIPTION: Currently, the U. S. Navy uses low pressure chambers for hypoxia recognition and recovery training. The training consists of exposure to hypobaric environments at or above 20,000 feet. Nearly 10,000 students receive hypobaric training in the U.S. Navy annually. The risk of decompression sickness (DCS) increases substantially at altitudes above 18,000 feet. Because of the risk of DCS, inside observers receive hazardous duty incentive pay ($150.00 per month X 80 inside observers = $12000.00 per month). The incidence of decompression illness resulting from hypobaric chamber training has been reported by a number of military training organizations. A review of 10 of these reports reveals a range of incidence in various populations from 0.3 to 2.9 cases per 1000 exposures, with a mean incidence of 1 case per 1000 exposures (or 0.1%). The Navy has on average 4 cases of DCS annually in its hypobaric chambers with an associated cost of several thousand dollars per treatment, with the possibility of long term medical complications for the patient.

The U.S. Navy has recently reported the success of using mixed gas (normobaric hypoxia) for the hypoxia recognition and recovery training for tactical jet aviators using the Reduced Oxygen Breathing Device (ROBD). One advantage of using mixed gas is that the risk of decompression sickness is eliminated. ROBD training uses a mask delivered gas mixture to individual aviators. The Navy has identified this as a shortcoming for the training of aircrews that fly multi crew aircraft because the hypoxia scenario most likely experienced by multi crew aircraft aircrew would involve “mask off” hypoxia. Additionally, hypoxia recovery training for multi crew aircraft aircrew involves crew communication and coordination. This is not feasible with ROBD training. As a result, the U. S. Navy continues to use low pressure chamber training for multi crew aircraft aircrew. Additionally, practicing pressure equalization in a hypobaric environment is a required objective of U. S. Navy Indoctrination Aviation Survival Training.

A preferred training approach would be a combination of hypobaric and normobaric (mixed gas) hypoxia for multi crew aircraft aircrew training. Hypobaric exposure need not exceed 8-10,000 feet, eliminating the risk of decompression sickness, but allowing the practicing of pressure equalization. The normobaric exposure should allow exposure to up to 35,000 feet of simulated altitude (in combination with 8-10,000 feet of hypobaric exposure).

An additional benefit of this approach is that fewer inside observers can be used, freeing up space to reconfigure the inside of the low pressure chamber to increase training realism. The low pressure chambers can be equipped with aircrew task stations to mimic the types of duties that they would normally engage in while flying (i.e., navigation, flying, operating weapons systems) to increase training fidelity.

PAST EFFORTS, CHALLENGES, AND RISKS: The Navy has investigated the use of mixed gas for hypoxia training in its altitude chambers in the past. However, at that time, the technology was not available to provide sustainable altitudes in excess of 25K feet. Recently the Navy has instituted mixed gas training at altitudes of 25K feet and above, but the technology being used provides enough mixed gas for one to two students receiving the gas mixture through an oxygen mask. The Australian armed (Newman, DG, 2007) forces are using mask delivered mixed gas in their low pressure chambers. As previously discussed, the use of a mask to deliver mixed gas is not appropriate training for aircrew that do not fly with a mask. The previous technological challenges are being solved with newer technology. Several companies are now able to deliver larger quantities of mixed gas and have even constructed large space, mixed gas rooms that are capable of maintaining altitudes in excess of 25K feet. What remains is to integrate the mixed gas technology with low pressure technology so that hypoxia can be trained with mixed gas and low pressure can be used to train the effects of pressure changes. This integration appears to be within reach of the current technology.

PHASE I: Demonstrate proof-of-concept of proposed technology to deliver controllable gas mixture and define the technical approach for incorporating this technology into low pressure chamber training.

PHASE II: Design, develop and demonstrate a prototype mixed gas system that integrates into existing low pressure chambers.

PHASE III: Transition the technology to a commercially available retrofit system capable of transforming low pressure chambers into a mixed hypobaric, normobaric training system for use by the U.S. Navy and other military and private interests.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The U. S. military services currently use hypobaric chambers for hypoxia recognition and recovery training. In addition, many foreign services and a multitude of civilian organizations around the world are using hypobaric chambers for hypoxia training and research. This technology has the potential to increase the effectiveness and safety of this type of training and research.

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KEYWORDS: hypoxia; safety; aviation physiology; human factors; hypobaric; training

N08-140 TITLE: Improved Low Light Level, Wide Multi-Band Infrared Imager

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA264 JMMES JCTD; PMA-290 P-8A Poseidon Multi-Mission Aircraft

OBJECTIVE: Develop an infrared (IR) detector array sensitive to, at a minimum, long wave and mid wave IR wavelengths and requires little to no cooling.

DESCRIPTION: A detector array with a low cost and high sensitivity across the IR spectrum that requires little to no cooling is desired. Sensitivity in the near IR would also be desirable. Broad band performance across the visible, near IR, short wave IR, mid wave IR, and long wave IR bands would be beneficial, but is not required. New technology advancements have the potential to provide focal plane arrays that do not require cooling and have increased sensitivity and lower cost than existing array techniques. Two of these new technologies include the use of: 1) Nano engineered photonic materials that can be engineered with specific bandgaps for optical wavelengths, particularly the long wave and IR where the atomic structures a still much smaller that the wavelengths. 2) Micro-machined array structures that can detect with, differential resonance techniques, very small thermal changes. These and other advances in material and manufacturing techniques can be applied to potentially improve IR image plane performance.

PHASE I: Determine the feasibility of developing an IR detector array requiring little or no cooling. Demonstrate that this array technology can be scaled to array sizes of at least 1000 by 1000 pixels with suitable development. Demonstrate the modeling of key performance parameters representing Phase II risk via an engineering model. Demonstration of key performance requirements is desired.

PHASE II: Design, build and demonstrate a prototype IR detector array. This demonstration may use a smaller array with a goal of approximately 500 by 500 pixels. A demonstration using a full sized array would be preferred. Utilizing information gathered during the demonstration, build the IR array into a usable camera for demonstration.

PHASE III: Integrate into an existing Navy Aircraft Turret for demonstration and comparison to current IR sensor systems. Transition technology by replacing sensors currently in use in the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Low cost imagers for IR would have a large commercial market for thermal imaging - including energy efficiency measurements and fire fighter imaging.

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Hardcover (Trade Cloth) Author: Ronald G. Driggers

3. TESTING AND EVALUATION OF INFRARED IMAGING SYSTEMS / Second edition by Gerald C. Holst, JCD Publishing. All Rights Reserved. 2932 Cove Trail | Winter Park, FL 32789-1159 | Ph. +407.629.5370 | Fax. +407.629.5370 |

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KEYWORDS: Long Wave Infrared; Mid Wave Infrared; Near Infrared; Imager; Array; Thermal; photonic materials; micro-machining

N08-141 TITLE: Design and Optimization of Radar Systems to Assist Rotorcraft Piloting in Adverse Environments

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-261, CH-53K Heavy Lift Helicopter, ACAT I; PMA-209

OBJECTIVE: Develop innovative analysis tools for the design and optimization of Ka through W band radar systems for rotorcraft piloting in adverse environments. The sensors are to support the safe approach and landing during brownout, whiteout, and sea spray as well as improved safety for night and no/low visibility low altitude pilotage.

DESCRIPTION: Rotorcraft routinely operate in brownout conditions during their approach to landing and during take off in desert environments. Snow and sea spray can also produce similar degraded visual environments. The reduction in visibility presents a danger from unseen aircraft maneuvering nearby, uneven terrain, wires and other obstacles. Even in what is considered good visibility conditions, the visual detection of electrical power lines is difficult.

The design and optimization tools should be able to provide analysis in support of tradeoffs between near-field and far-field sensor performance, interaction of the antenna/array with the airframe, achievable radar beam width and resultant angular resolution of the radar imagery, consider the impact of polarimetry techniques to improve the detection and discrimination of power lines in a high clutter background. Consideration should be given to modeling the effects of precipitation, sea spray and dust clouds. In the case of dust clouds, particles of particular interest range in size around 60 microns (i.e. particles which impact visibility), and are at concentrations of 0.25 to 3 grams per cubic meter. The analysis capability shall also address the sensor system's ability to display surface objects that would damage the aircraft (including rotor blades) during the final portion of the approach and to detect objects that have moved during final portion of decent.

We desire innovative analytical/numerical, exact or approximate physics methodologies that can provide fast solutions to these problems. These methodologies should be capable of handling large targets with small features (large/small scale capable); they should provide highly accurate results for far-field quantities and accurate ones for near-field ones; and they should be able to handle a variety of materials besides perfect conductors. They should provide solutions faster than accepted exact frequency-domain methods but slower than purely high-frequency methods (UTD, PTD, etc). The latter are excluded from this call. This topic is restricted to frequency-domain methods.

PHASE I: Determine feasibility of proposed solution to address the problems above. The proposed methodology should be based in the frequency domain. Demonstrate by either analytical and/or computational methods, the capability of the proposed method.

PHASE II: Develop and demonstrate proposed methodology. Demonstrate accuracy, robustness and speed of the established method. Develop a prototype electromagenetics tool incorporating new methodology and including a user-interactive graphical user interface (GUI).

PHASE III: Refine methodology and tool developed in Phase II either alone or in partnership with another company and transition to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The tool developed in this project will find applications among commercial airframe builders, antenna houses, communications equipment manufacturers, etc.

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4. Park, M. "Millimeter-Wave Polarimetric Radar Sensor for Detection of Power Lines in Strong Clutter Background" PhD Dissertation, University of Michigan, 2003.

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KEYWORDS: Brownout; RF sensors; Large Platforms; Small Features; Fast Electromagnetic Solvers; Frequency Domain.

N08-142 TITLE: Innovative Aircraft Engine Noise Reduction Using Tailored and Smart Acoustic Liners

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Sensors

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop innovative acoustic liners for jet noise reduction as alternatives to current perforated designs.

DESCRIPTION: Aircraft engines generate noise levels that are deemed unacceptable for 21st century survivability and community noise objectives. Recent government funded research programs have set aggressive goals for jet noise reduction for the near future. Reductions of the order of 20 dB to be achieved in the next 15 years require the development of new technological solutions for the control of noise generated by jet engines.

Current design configurations mostly feature passive acoustic liners consisting of honeycomb panels with perforated face sheets. Single-, double- or triple-layer configurations have been proposed and analyzed in an effort to increase design flexibility and broadband absorption characteristics. Other configurations employ woven wires, slots and micro-perforates as well as bulk absorber materials such as fiberglass, Kevlar felts, and ceramic foams. Most of these design solutions suffer from major drawbacks in terms of manufacturing and in-service durability. In addition, these liners typically do not contribute to the structural capability of the engine, and therefore they introduce weight penalties. Finally, passive liners do not have the ability to adapt their absorption characteristics in response to varying flight regimes. New concepts for acoustic liners should reduce the drawbacks of current designs in terms of manufacturing and structural reliability and should have tunable properties.

Smart acoustic technology is sought for liners that contribute to the structural strength of the engine nacelles and have the ability to adapt their noise absorption characteristics to different flight regimes through the application of smart or tunable materials while maintaining current engine performance levels. The developed technology must ensure no adverse effect on infrared (IR), fatigue, flutter, or engine performance.

PHASE I: Develop an innovative approach to a smart acoustic system that detects and reduces aircraft engine noise as a function of flight regime. Demonstrate the feasibility of the approach using computational methods.

PHASE II: Develop and demonstrate a prototype smart acoustic system in a simulated environment where a representative engine noise environment can be produced. Both experimental evaluation and verification via proven computational methodologies must be demonstrated.

PHASE III: Further develop the smart acoustic system for production. Prepare a complete package with a users manual, hardware and software for the system to be integrated onto Navy platforms. Provide the Navy with computational tools capable of assessing the system across a spectrum of Navy aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Smart acoustic system technology will have broad application in both the commercial and military aerospace industries where community aircraft engine noise is an issue. This technology can be applied to reduce civilian noise footprints for airports and heliports.

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KEYWORDS: Smart System; Engine; Acoustics; Noise; Structural Tailoring; Structural Control.

N08-143   TITLE: Long Endurance, High Power Battery

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes, Battlespace, Nuclear Technology

ACQUISITION PROGRAM: PMA-264 - Air ASW Systems; PMA-290 - Maritime Patrol and Reconnaissance Air

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a lightweight, long endurance, high power output, low cost sonobuoy and Unmanned Aerial System (UAS) battery to replace current chemistry and endurance limitations given the volume, weight and safety constraints.

DESCRIPTION: The current sonobuoy battery is a magnesium/silver-chloride battery (18 volts, 8.2 amp/hour, 120watt, for 6 hours weighing 2.48 pounds in a volume of 4.29 inch diameter by 2.54 inches in height). There is an excessive amount, approximately 20 troy ounces, of silver per battery currently used.

The current UAV-sonobuoy battery is a lithium-polymer battery. There are limitations and various physical configurations and power requirements which will be a derivative of the sonobuoy battery listed above. There are two goals for the sonobuoy-UAV battery and they are; 1) reduction in the interior volume and 2) increasing flight endurance.

The battery must be able to be certified for Naval aviation and be environmentally safe. All chemistries and nuclear options will be considered.

PHASE I: Determine the feasibility of developing a long endurance, high power battery. Perform design and analysis of high power density, low cost battery system, and define its performance characteristics, develop a design configuration, safety and environmental parameters, and select the major components for proving the feasibility of the proposed system. Analyze all possible failure mechanisms and estimate battery reliability, based on the performance of the electrical and mechanical subsystems.

PHASE II: Design and develop a full-scale prototype battery ready for sonobuoy and sonobuoy-UAS installation and conduct a land-based demonstration.

PHASE III: Design and fabricate production prototypes for both sonobuoy and sonobuoy-UAS and transition to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Batteries of this type have the potential of being used by volcanic and polar ice expeditions where long duration remote sensor operation is required.

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4. Navsea Technical Manual for Batteries, Navy Lithium Safety Program Responsibilities and Procedures, August 19, 2004, 53 pgs.
REF N08-143 Navsea Tech Manual Batteries.pdf

KEYWORDS: Sensors; Battery; Nuclear; Chemical; Power; UAV.

N08-144 TITLE: Erosion Resistant Coatings for Large Size Gas Turbine Engine Compressor Airfoils

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop and apply erosion resistant coatings to large size compressor airfoils.

DESCRIPTION: Aircraft operating in sand/dust environments experience erosion of the gas turbine engine compressor airfoils that deteriorates engine performance; increases fuel consumption; increases maintenance, logistic support, and costs; and decreases safety-of-flight. Solutions from inlet barrier filters to erosion-resistant coatings have been applied to helicopter engines operating in desert environments and have resulted in increased engine time-on-wing and engine performance retention. Erosion-resistant coatings have been applied on helicopter engines with compressor airfoils measuring no greater than 10 cm in length. The Joint Strike Fighter Short Take-off and Vertical Landing (STOVL) aircraft will operate in desert environments and ingest abrasive particles during the critical take-off and landing stages of operation. The compressor airfoils on the JSF STOVL aircraft's integrally bladed rotors (IBR) for both the lift-fan and cruise engines are much larger than compressor airfoils on helicopter engines. For example, a first-stage IBR can measure approximately 1 meter in diameter. The large-size IBRs are expensive to manufacture and replace; hence, the potential of an erosion-resistant coating maintaining component efficiency and delaying component degradation of large diameter IBRs will be critical in reducing total operating costs. This project seeks erosion-resistant coatings that can be applied on large diameter, integrally bladed rotors for gas turbine engine compressors on a production basis. The coatings must be able to withstand the austere operating environments of gas turbine engines such as high cycle fatigue and stresses due to surge and aerodynamic and centrifugal loads. At the same time, they should not spall or delaminate after absorbing foreign object damage.

PHASE I: Determine the feasibility of applying erosion-resistant coatings on large-diameter integrally bladed rotors for gas turbine engine compressors on a production basis.

PHASE II: Demonstrate the application of the coating on a large diameter IBR. Conduct erosion tests on coated, large diameter IBRs. Demonstrate that the coating process for large diameter IBRs is ready for application on a production basis. Provide non-recurring and recurring costs to apply production coatings.

PHASE III: Transition application of the selected erosion-resistant coatings to the JSF engine compressors.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The application of erosion-resistant coatings on large diameter compressor airfoils and IBRs has potential application for compressor airfoils on large turbofan engines powering commercial aircraft fleets.

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1. Tabakoff, W. and Simpson G., “Experimental Study of Deterioratiion and Retention on Coated and Uncoated Compressor and Turbine Blades,” 40th AIAA Aerospace Sciences Meeting &Exhibition, Reno, NV, Jan 14-17, 2002.

2. Klein, M.A. and Simpson G., “The Development of Innovative Methods for Erosion Testing a Russian Coating on GE T64 Gas Turbine Engine Compressor Blades” GT2004-54336, Turbo Expo 2004, Vienna, Austria, June 14-17, 2004.

KEYWORDS: Erosion; resistant; coatings; airfoils; integrally bladed rotors (IBRs); gas turbine engines.

N08-145 TITLE: <u>Relative Global Positioning System/ Inertial Navigation System (GPS/INS) Innovations for Autonomous Unmanned Air Systems (UAS)</u>

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: Navy Unmanned Combat Air System (N-UCAS)/ACAT 1

OBJECTIVE: Develop and demonstrate architecture innovations for precision relative GPS/INS navigation systems that satisfy the stringent accuracy, integrity and continuity performance required to support autonomous, networked, low-observable (LO) unmanned air systems.

DESCRIPTION: Precision GPS/INS techniques have been developed to support operations including automated aerial refueling (AAR) and autonomous shipboard launch and recovery. The basic architecture of a relative GPS/INS navigation sensor system sends GPS and INS sensor measurements from the host platform (tanker or ship) to the unmanned aircraft platform via the airborne data network. Supporting communications and situational awareness functions are exchanged on the same network. Autonomous UAS bring additional challenges to the performance of these systems including the impact of low observability, networking interface, scalability, redundancy, and autonomy. Specific technology innovations are needed to advance the state of the art of precision GPS/INS techniques for autonomous UAS systems, including the following:

• Impact of Low Observability. Low observability may attenuate GPS antenna performance significantly from non-LO designs. Degradation in tracking thresholds reduces system performance and availability. Methods of addressing this degradation can include the use of external augmentations (to compensate for satellites unable to track) such as two-way ranging via the data network and precision time transfer; techniques to increase the available

gain to each satellite such as active antenna multi-beamforming; and techniques to lower the carrier-to-noise ratio, which provides quality GPS carrier tracking, such as GPS/INS deep integration. Preferred techniques minimize cost and integration impact to the platform while maximizing availability of system performance.
• Autonomy and Airborne Redundancy. Autonomous UAS require very high continuity in the GPS/INS system, since there is no piloted backup to the navigation operation. Operation of redundant GPS/INS processors requires that errors can be detected between the navigation outputs at the submeter-level with high integrity (high assurance of fault detection) and high continuity (low false alarm rate). Architecture innovations are desired to improve performance of redundant systems including fault detection and isolation algorithms.
• Networking and Service Oriented Architecture (SOA). Autonomous UAS achieve interoperability, scalability, and re-usability through implementing communications, navigation, command and control and other mission functions over a SOA implemented via the Internet-Protocol based airborne network. Innovative concepts are needed to select SOA frameworks for GPS/INS data exchanges that provide open architecture, re-usability and scalability across large, networked "swarms" of UAS while still supporting the performance needed for aviation operations. Specific challenges include security, efficiency, latency, certification and robustness of performance.

In all cases the architecture innovations must satisfy the stringent accuracy, integrity and continuity performance of precision UAS operations such as AAR and carrier-based autonomous launch and recovery.

PHASE I: Design and demonstrate a cost-effective approach to using differential GPS/INS augmentations to provide a significant improvement in performance on LO UAVs.

PHASE II: Develop a prototype of the relative GPS/INS innovation including the necessary hardware, software, and associated simulations. Using the prototype with simulation and field/flight test data, demonstrate the performance under representative conditions via real-time or post- processing.

PHASE III: Integrate the innovation approach into an existing precision relative GPS/INS system applicable to autonomous UAS operations in precision relative navigation. Demonstrate performance in flight test conditions in a relevant environment.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Precision relative navigation can be used for a host of vehicle-to-vehicle navigation applications in the private sector. Precision relative navigation is related to the general class of differential GPS systems and augmentations used in civilian transportation, farming, mining, and other sectors. In particular, the required navigation performance for unmanned air platforms is on the same order as performance requirements for Cat III Local Area Augmentation System (LAAS).

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2. NA-4150-UCAS-1003, UCAS Ship Interface Reference Document (USIRD).

3. NA-4580-PGPS-5000, PGPS System Requirements Document.

4. Navy UCAS: Aviation/Ship Integration Architecture Process, ASNE Launch & Recovery, May 2008, PR No. 07-743, 32 pages.

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7. Heo, Moon-Beom et al, Robust Airborne Navigation Algorithms for SRGPS, 2004, 9 pages.

8. Khanafseh, S. et al, Carrier Phase DGPS for Autonomous Airborne Refueling, 11 pages.

9. Liu, K. et al, Precision Relative Navigation Solution for Autonomous Operations in Close Proximity, IEEE/ION Plans 2008, Monterey, California, May 5-8, 2008, 6 pages.

KEYWORDS: Navigation; Unmanned Air System (UAS); Global Positioning System (GPS); Inertial Navigation System (INS); Low Observable (LO); Service Oriented Architecture (SOA).

N08-146 TITLE: Cross-Cockpit Collimated Displays for Flight Simulation

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

OBJECTIVE: Develop innovative technology for large field-of-view, multi-viewer collimated displays with demonstrated significant cost and fidelity improvements.

DESCRIPTION: Innovation is sought for large-area, large field-of-view, multi-viewer (two or more), collimated displays used in flight simulators that require cross-cockpit viewing and in other applications requiring a large viewing volume for multiple viewers. Current systems are expensive and have a number of performance and quality deficiencies. Specific areas in which advancement is needed include:

a) Mechanical installation and alignment.
b) Ease of maintenance.
c) Distortion correction.
d) Brightness and contrast.
e) Color matching between display channels.
f) Shared field-of-view.

Significant cost and fidelity improvements are sought using new processes and materials. Proposed solutions should also leverage new PC based image generation and display technologies.

PHASE I: Develop innovative concepts for shared collimated display systems in training simulators and perform a feasibility analysis of the proposed concept.

PHASE II: Develop the proposed concept identified in Phase I and evaluate it in a demonstration display unit.

PHASE III: Integrate the new processes, software algorithms, hardware, and other developed technology into a commercially viable large-area multi-viewer collimated display system suitable for use in a high-fidelity military flight simulator.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The developed technology can be applied in commercial flight simulators requiring pilot, co-pilot, crew, and instructor viewpoints. It is also applicable for multi-person visual display entertainment venues.

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1. Dudfield, H.J.; Macklin, C.; Fearnley, R.; Simpson, A.; and Hall, P. (2001) “Big Is Better? Human Factors Issues Of Large Screen Displays With Military Command Teams,” in Proc. of People in Control: 2nd International Conference on Human Interfaces in Control Rooms, Cockpits and Command Centres (PIC 2001), IEE Press, 304-309.

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KEYWORDS: Maintenance; Collimated; WIDE-Displays; Simulation; Displays; Trainer.

N08-147 TITLE: Improve LASER RADAR (LADAR) Image and Data System Processing with Multi-Sensor Fusion in Vertical Lift Visual Degraded Environments

TECHNOLOGY AREAS: Air Platform, Electronics

ACQUISITION PROGRAM: PMA 261 - Heavy Lift Helicopter, ACAT I; PMA-275; PMA-209

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OBJECTIVE: Develop innovative LADAR technologies which improve upon the signal processing of Laser pulse returns to provide higher image resolution, greater range resolution, increased update rates, and larger Field of View (FOV).

DESCRIPTION: Navy and Marine Corps helicopter operations under visually degraded environment (VDE) conditions during landings and troop insertions/extractions have resulted in accidents caused by the pilot and aircrew loss of Situational Awareness (SA). VDE results when the pilot and aircrew are unable to recognize objects and terrain due to blowing dust/snow (brownout / whiteout) conditions, or dense fog. Pilots and crew operating aircraft under such desperate conditions require high image resolution (1024 x 720, or 1280 x 1080 pixels) and range accuracy (in centimeters) at rages of 100 to 1000 ft in real time that allows imaging of desired target area and associated objects within such zone while operating aircraft in a VDE. LADAR imaging sensors offer an imaging capability that could penetrate brownout/whiteout conditions and support landing in VDE. However, current LADAR sensors have low spatial resolution (256 x 256, or 512 by 512) and limited field of view (30 to 60 degrees) in order to achieve near real-time display imagery. In addition, to obtain desired range accuracy in the decimeter to centimeter range requires post collect processing. Processing technologies for enhancing and/or fusing LADAR and other sensor sources should enhance object detection and identification within the sensor’s FOV, allowing pilots to recognize hazards associated with the safe operation of the aircraft. Therefore, innovative signal and image processing technologies are hereby sought that would provide a pilot such an enhanced fused image of the landing area. This should as a minimum include active gated LADAR imaging and fusion of other sensor sources such as millimeter wave (MMW), low/visual light cameras and infrared video sensors. In addition, consideration should be given to approaches that also address the vertical lift operations in VDE. Consideration shall be given to scaling proposed technologies to the size weight, and power consumption available in the helicopter environment.

PHASE I: Determine the feasibility of developing new processing technologies and system architectures that increase effective LADAR image resolution, range accuracy, and increase FOV imagery in real-time to pilots (no apparent processing-time difference as view by the pilot compared to what he would see outside the aircraft with no VDE). Consider the fusion of other sensor data to enhance the detection and identification of objects and terrain features. Describe how fused imagery data from other sensor with improved LADAR imagery processing can enhance pilot SA in a VDE. Describe how current technologies compare to proposed LADAR sensor processing technologies.

PHASE II: Develop prototype or modify existing LADAR system with proposed new technologies and architectures to improve senor system performance and pilot SA. Test the prototype developmental unit to assess its imagery resolution, range resolution accuracies, expanded FOV, and real-time processing capability enhances the detection and recognition of objects and terrain features in laboratory (in door/outdoor) environments.

PHASE III: Integrate a developmental unit onto a helicopter testbed or lead platform helicopter platform. Demonstrate real-world operation of the system in a VDE and its capability to enhance pilot and aircrew SA in such austere environments. Refine hardware and software solution to improve and optimize system performance. Upon successful system performance demonstration, start process of ruggedizing and integrating system for Naval helicopter environment and operations on a designate lead platform. Also perform studies to determine where such sensor or sensors could be mounted on lead platform.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed could be applicable to commercial aircraft builders and aircraft operators, particularly for helicopter manufactures and fleet operators. This technology would also be applicable to life-saving, law enforcement, Department of Homeland Security, and US Coast Guard helicopter aviation units.

REFERENCES:
1. National Defense, Aug 2007, " Sandblaster Gives Helicopters Hope for Safe Landing"

2. Air Force Research Laboratory, 28 Aug 2007, "AFRL Develops Partial Solution to Helicopter Brownout"

3. Popular Mechanics, 3 Oct 2006, "Flying Blind in Iraq: U.S. Helicopters Navigate Real Desert Storms"

KEYWORDS: LADAR; visual degraded environment; brownout; whiteout; enhanced situational awareness; ladar image processing

N08-148 TITLE: <u>Innovative Approaches to the Optimization of Ceramic Matrix Composite (CMC) Component Manufacturing Processes</u>

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I

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OBJECTIVE: Develop methodologies to support innovative manufacturing process development to ensure optimized CMC component fabrication.

DESCRIPTION: The Joint Strike Fighter and other military systems are considering the use of CMC’s for propulsion applications. The materials are exposed to several densification and cure cycles during processing. Special precautions need to be taken during the densification process to ensure that the parts do not warp and twist during processing even through the fabric architecture is mid-plane symmetric. Additionally when fabricated components are subjected to engine operating conditions, the components may exhibit permanent deformation in the form of warping or twisting. This warping and twisting can be a direct result of a build up of residual stresses that are processing induced, depending on the part geometry. Permanent deformation to these critical components may result in premature failure and/or require premature replacement. Innovative approaches are required to supplement the manufacturing process to ensure proper component fabrication.

PHASE I: Develop a methodology that will provide for the optimization of the critical CMC processing procedures. Demonstrate the feasibility of the approach through the fabrication of a limited quantity of specimens.

PHASE II: Fully develop the approach into a manufacturing process tool. Provide sufficient verification and validation through manufacturing trials to enable a transitionable product.

PHASE III: Expand the technology for other materials, environments, and structural applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed here will be applicable to the chemical processing industries that utilize high temperature CMC systems.

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3. Lee, S. Steven, Zawada, Larry P., Staehler, James M., and Folsom, Craig A. “Mechanical Behavior and High Temperature Performance of a Woven Nicalon/Si-N-C Ceramic Matrix Composite.” J. Am. Cer. Soc. Vol. 81, No. 7, 1998.

KEYWORDS: Ceramic matrix composites (CMCs); processing; fabrication; propulsion; manufacturing; densification.

N08-149		TITLE: Variable Speed Speech Synthesis

TECHNOLOGY AREAS: Information Systems, Human Systems

ACQUISITION PROGRAM: PMA205 - Aviation Training Systems

OBJECTIVE: Develop a speech synthesis technology that provides realistic and adjustable speed of speech that is intelligible to support a range of fast pace operational and training scenarios.

DESCRIPTION: Speech synthesis technology is integrated into training systems to provide team training to individual trainees. However, the current state of the technology does not support the demands of high-speed training scenarios. For example, in Close Air Support training, a Forward Air Controller is required to interact with a pilot as quickly as possible due to the limited time that the aircraft is within range. Current speech synthesis technologies do not allow trainees to interact in a realistic manner in these types of training scenarios. A speech synthesis technology is sought that can be adjusted to provide realistic speed variations for fast paced training scenarios while maintaining intelligibility.

PHASE I: Determine the feasibility of developing variable speed speech synthesis technology that allows the user to vary the speed to meet high-speed training scenarios while maintaining intelligibility. Determine and document how speech synthesis technology can be advanced to meet the requirements of variable speed.

PHASE II: Develop, test, and validate the new speech synthesis technology. Creatively demonstrate how users can adjust speed variability to meet the needs of a range of training scenarios and the capability of the technology to produce clear and unambiguous speech at various speed levels.

PHASE III: Transition effort to commercial developers and government research and development facilities responsible for providing training systems that integrate speech technologies, as well as to operational environments that may benefit from enhanced speech synthesis technologies (e.g. Air Traffic Control for Unmanned Aerial Vehicles).

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Any organization that utilizes speech synthesis technology to support development of tools to support accessibility (e.g., screen readers for people with visual impairment) and telephone-based systems (e.g., automated call centers). The technology would also be useful to government, industry and academic organizations that develop training systems that require the user to interact with a computer to train team skills.

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2. Text-to-Speech Designed For a Massively Multiplayer Online Role-Playing Game (MMORPG) by Mike Rozak; http://festvox.org/blizzard/bc2007/blizzard_2007/full_papers/blz3_011.pdf
Speech Synthesis Using an Aeroacoustic Fricative Model by Daniel J. Sinder; http://www.caip.rutgers.edu/~sinder/thesis/.

3. Speech synthesis evaluation by Nick Campbell; http://www.elra.info/hltevaluationworkshop/img/pdf/Nick%20Campbell.ATR.Speech%20Synthesis%20Evaluation.pdf.

4. Speech Conductor by Christophe d'Alessandro; http://www.enterface.net/enterface05/docs/slides/opening/project6.ppt#256,1,Speech Conductor.

5. Speech Synthesis Markup Language Version 1.1 Requirements by Scott McGlashan; http://www.w3.org/TR/ssml11reqs/.

6. A Perspective on the Next Challenges for TTS Research by Juergen Schroeter, Alistair Conkie, Ann Syrdal, Mark Beutnagel, Matthias Jilka, Volker Strom, Yeon-Jun Kim, Hong-Goo Kang, and David Kapilow; http://www.cstr.ed.ac.uk/downloads/publications/2002/strom02a.pdf.

KEYWORDS: Speech Synthesis; Training; Speed Variability; Simulation; Communications; Coordination.

N08-150 TITLE: Very Rapid Cure Capable Resin and Optimization for Pre-Preg Process Development of Barrier or Isolation Ply Materials

TECHNOLOGY AREAS: Air Platform, Materials/Processes, Weapons

ACQUISITION PROGRAM: Joint Strike Fighter Program Office, Airframe IPT, ACAT I D Program

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OBJECTIVE: Develop a cost-effective controllable very rapid curing resin and pre-preg system for galvanic barrier or isolation ply restoration on complex pre-cured and machined carbon composite part surfaces. The system is to be based on proven epoxy chemistry resins for barrier or isolation ply applications with type "E" glass 108 style fiberglass cloth.

DESCRIPTION: New developments in very rapid cure resin systems have overcome limitations of legacy properties associated with these novel resin systems; including, but not limited to, brittleness, aircraft fluid and environmental sensitivity, unpredictable cure, and low glass transition temperature. Rapid resin cure is considered to be orders of magnitude less than current thermal cure processes while eliminating many time consuming processing steps; with no post processing required. An objective of this effort will be to develop a system that includes the epoxy based rapid and controllable cure resin and pre-preg processes needed to adequately impregnate the 108 style fiberglass cloth.

The proposed epoxy based rapid cure resin system with specified 108 style fiberglass cloth should meet the specific application of restoring the galvanic barrier or isolation ply corrosion protection on machined carbon composite surfaces that meets DoD aerospace fighter requirements. The final product form of the pre-preg must meet desired properties such as aerial weight, density, uniformity, thickness, etc. In addition, the pre-preg must meet the glass transition requirement of 375 F-dry via dynamic mechanical analysis (DMA) and demonstrated resistance to standard DoD aircraft fluids and environments. Final pre-preg properties will be assessed to ensure adequate performance for this application. Storage, handling and shipping of candidate pre-preg material should require no special environmental considerations beyond manufacturer packaging to remain stable and usable for processing - for example, no freezer/dry ice storage, but may require a protective package supplied via manufacturing process to limit cure from ambient light. The intention is for this candidate pre-preg material to be stored within a composite manufacturing center with typical constraints such as no direct sunlight and at temperatures typically found at an aerospace composite manufacturing center.

The candidate pre-preg along with the pre-preg life should include storage life, open mold life and be sufficient to meet the intentions of this program; allow for lay-up and subsequent rapid cure on large complex carbon composite parts to restore the galvanic corrosion barrier. Shelf life will be proven at the maximum extent possible within the capabilities of resin system, and be measured in tens of months rather than days or weeks.

PHASE I: Develop, perform analysis and perform optimization trials for a candidate baseline rapidly curing resin system. Demonstrate feasibility to pre-preg the resin while meeting physical and structural properties of the pre-preg and laminate. Demonstrate viscosity versus temperature evaluations of the resin and design a pre-preg process that will allow for flow and coating on the 108 style fiberglass cloth and cool sufficiently during the roll process to form an aerospace quality product with consistent thickness and resin content.

PHASE II: Develop and refine epoxy based rapid and controllable cure resin and pre-preg processes to provide for consistent product form on 108 style fiberglass cloth. This very rapid cure resin and glass cloth material could potentially be vacuum bag capable prior to and during cure process. Pre-preg properties will be assessed and provided to ensure adequate performance that meets this application; such as potentially, resin content, fiber area weight, volatile content, tack, cured ply thickness, density, glass transition temperature, adhesion, microcrack resistance, etc. Other woven fiber reinforcement materials may be explored for pre-pregging during this phase.

PHASE III: Design, fabricate, and test a pre-preg system with the optimized resin system developed in previous phases. The system must have the final production environment, limitations, and quantities required in mind during this phase of the program. Handling properties of the final pre-preg must be manufacturing friendly, and be able to be used with the standard set of tools and procedures available in a typical aerospace clean room of a composite manufacturing facility. Provide adequate system description and specifications to effectively transition the technology to the final pre-preg manufacturer.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The commercial aircraft manufacturers, automotive, and marine vehicle repair shops will benefit from the technology developed under this effort.

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"New Sandia UV LEDs emit short-wavelength, high-power output," Sandia National Laboratories Press Release, November 18, 2003.

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12. Black, S., "Technologies for UV Curing of Composite Laminates Demonstrated," www.compositesworld.com, April 2004.

KEYWORDS: Rapid cure resin pre-pregging; galvanic barrier ply restoration; automated pre-preg system; optimized rheology; quality assurance; glass transition.

N08-151 TITLE: Non-GPS Sonobouy Positioning System

TECHNOLOGY AREAS: Air Platform, Sensors

ACQUISITION PROGRAM: PMA 264 Air ASW Systems; PMA-290 Maritime Patrol and Recon. Aircraft

OBJECTIVE: Develop an innovative method of determining the position of sonobouys which does not require the use of Global Positioning Systems (GPS).

DESCRIPTION: Existing sonobouy positioning systems do not have the ability to adequately determine the location of sonobouys in the ocean. Mark on top indicators do not determine the range, and therefore cannot locate the position of the bouy with the 100 yds desired. Although small, low power GPS systems have been developed, they are easily jammed. An innovative alternative approach is desired that is less susceptible to jamming. Independence from the GPS satellite constellation and compatibility with low power sonobouy systems, including future digital and commandable units is desired. Low power usage within the expendable unit must be maintained as well. There are several potential new approaches that have become practical with the advancements in computer processing and software controlled radios that were not possible even several years ago. For instance 1) a phased array receiver with a software controlled radio can analyse in real time multiple signals, track the location via the array antenna, and locate each source with a very small radio / FPGA subsystem that can completely independent of the existing acoustic receiver systems; 2) Advanced computer tracking of multiple Doppler signals with computer controlled radio signal analyzers and computing systems can be used to locate transmitters, also independent of the existing systems and residing in a very small package.

PHASE I: Identify and define a positioning system for sonobouys drifting in the ocean. Develop an engineering performance model that can be used to analyze the expected performance of the approach. Cost, size and weight should be compatible with A size sonobouys. Demonstration of key attributes of the system in a laboratory environment is desired.

PHASE II: Demonstrate the prototype hardware by tracking of multiple simulated sonobouys in a moving field. A demonstration with floats in a real ocean environment should occur. All critical component performance attributes should be demonstrated to the extent possible – or a clear engineering / production path to obtain them presented.

PHASE III: Integration of engineering development models of the system into real sonobouys and aircraft (P-3, H-60, or surrogate) . Demonstration of system performance suitable to move the system into the NAVY POM cycle and integration. Transition the system into the sonobouys and aircraft used for monitoring the sonobouys.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology would potentially provide alternative methods to monitor the location and movement of personnel and equipment with radio transmitters, independent of GPS, in non-GPS environments like in a building or underground.

REFERENCES:
1. Introduction to GPS: The Global Positioning System (Hardcover) by Ahmed El-Rabbany-Available from Amazon Books

2. Global Positioning System: Theory and Practice (Paperback); by B. Hofmann-Wellenhof (Author), H. Lichtenegger (Author), J. Collins – Available from Amazon Books

3. Global Positioning System: Signals, Measurements, and Performance, Second Edition (2006) By Pratap Misra and Per Enge ISBN 0-9709544-1-7 Ganga-Jamuna Press, P. O. Box 692, Lincoln, MA 01773 .

4. Website: http://www.universal-radio.com/catalog/commrxvr/0014.html - Example of software radio capabilities

5. Chestnut, P. C., IEEE Transactions on Aerospace and Electronic Systems, vol. AES-18, Mar. 1982, p. 214-218. Emitter location accuracy using TDOA and differential Doppler; http://adsabs.harvard.edu/abs/1982ITAES..18..214C

6. Doppler Telemetry System for the Evaluation of Low Speed Movements in the Atmosphere; Mihail E. T_anase, Corneliu I. Toma, Dan Gh. T. Popa, and Ioan Lie; http://factaee.elfak.ni.ac.yu/fu2k43/Toma.pdf

KEYWORDS: Sonobouy; Position; Tracking; Location; Drift; Current; software radio signal analyzer

N08-152 TITLE: <u>System for Multi-Ship Brown-Out Helicopter Landings</u>

TECHNOLOGY AREAS: Air Platform, Information Systems, Sensors

ACQUISITION PROGRAM: PMA-261 - CH-53K Heavy Lift Helicopter, ACAT I

OBJECTIVE: Develop data management technologies to assist multi-ship helicopter landings in areas where severe dust is expected from rotor downwash (ie. brown-out). In particular, the system should allow trailing aircraft to land in completely blind conditions created by the lead aircraft.

DESCRIPTION: The concept of operations assumes that the lead aircraft is equipped with a laser capable of making high resolution, precision, three dimensional (3D) measurements of the landing zone. The lead aircraft will typically collect the data during approach to landing. On some missions, such as a rescue, the lead aircraft may first over-fly the objective area, scan straight-down, and circle back for the approach. An on-board processor then filters and converts the large amount of 3D point-cloud data into a relatively small terrain/obstacle elevation database. Any experience in converting point-cloud data into terrain elevation grids should be included in proposals.

The processor that computed the terrain elevation database also works out a desired ground track, altitude profile for the ground track, and time schedule for each aircraft in the formation. This information is then transmitted to each aircraft in formation. Each aircraft in formation also transmits its own location, horizontal velocity (vector) and horizontal acceleration (vector) to every other aircraft. Each pilot in formation then has all the necessary information on a display to do completely blind, formation landings. The design of the display is part of this SBIR contract effort.

The bulk of this effort is expected to be in developing innovative data management technologies to process the laser point cloud data into a terrain elevation database. In particular, the data must be filtered to remove bad points including any hits from dust particles. In order to detect wires (which have a small percentage of laser hits on the wire and a large percentage of near-misses which hit the terrain below the wires), new and innovative filtering methods may need to be developed. Any experience in filtering laser data should be included in proposals.

PHASE I: Demonstrate proof of concept of proposed data management technologies to assist multiple-ship helicopter landings. Determine the feasibility of developing an algorithm to convert laser point cloud data into a terrain elevation database, including filtering out bad samples and enhancing the detection of wires. The algorithm should also transmit the data to a remote computer processor efficiently. The government will provide laser data, sampled near horizontally, as GFI during Phase I.

PHASE II: Develop a prototype system consisting of a laser sensor, data processing algorithm, and display. Demonstrate that the data processing algorithm has the capability to eliminate bad samples from dust particles, and can detect terrain, towers, and wires. In order to reduce costs, the laser sensor for this prototype may be less capable than that required for operational use (sample rates, ranges, etc.). Develop sample flight algorithms/planning routes for multi-ship helicopter landings.

PHASE III: Integrate the processing algorithm and associated terrain elevation data base with an existing laser sensor and associated display found on a military helicopter. Develop flight algorithms/ planning routes for multi-ship helicopter landings. Test the system under brownout conditions at an available test range.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: On the commercial side, Emergency Medical Services helicopters can over-fly and scan landing sites before landing, reducing accidents due to collision with wires and poles. Aerial mapping services can use this system to map wires and towers over non-hostile areas, and sell databases of obstacles.

REFERENCES:
1. Kayton M., Fried W., “Avionics Navigation Systems” 2nd Ed., John Wiley and Sons Inc., 1997.

2. Graham R., Koh A., “Digital Aerial Survey Theory and Practice”, Whittles Press., 2002.

3. Johnson A., Pettersson C., “Geographic Information Systems and Mapping / Practices and Standards, ASTM, 1992.

4. Bossler J., Jensen J., McMaster R., Rizos C., “Manual of Geospatial Science and Technology”, CRC Press., 2002.

5. Bartlett D., Smith J., “GIS for Coastal Zone Management” CRC Press, 2004.

6. Jacobs G., “High Definition Surveying – 3D Laser Scanning: What kind of projects benefit most”, Professional Surveyor, Vol. 24., No. 8, August 2004.

7. Satyaprakash, “Laser Scanners in Terrestrial Surveying”, The Global Geospatial Magazine, Sept. 2007.

KEYWORDS: Brownout; Degraded Visual Environments; Ladar; 3D Database; Situation Awareness; Rotorcraft.

N08-153 TITLE: Digital Method for Improved Custom Hearing Protection Equipment

TECHNOLOGY AREAS: Air Platform, Space Platforms, Human Systems

ACQUISITION PROGRAM: F-35 - Joint Strike Fighter, ACAT I; PMA-202 Aircrew Systems

OBJECTIVE: Develop an accurate, efficient, robust capability to digitally capture ear canal geometries and to share, archive, access, and manipulate those digital databases to provide custom earplug designs with a minimized logistical burden.

DESCRIPTION: Custom earplugs are being pursued for military aviation crews as a way to motivate earplug use and to ensure a level of noise attenuation that wearers can easily and reliably achieve (since custom earplugs only fit in the ear canal one, correct way). However, the process to shape and build custom earplugs is limited and lacks logistical efficiency, particularly in the context of deployed aircraft carriers. Currently, ear canal impressions are taken in a manner similar to that used for hearing aids. A foam stopper is positioned a safe distance from the eardrum and the ear canal is filed with silicone that hardens to become an impression. These impressions are sent to a manufacturer who then uses them to build custom earplugs. Storage and subsequent retrieval of individual impressions are at the vendors' discretion.

An innovative solution is sought that will eliminate the need for acquiring physical ear canal impressions and offers the ability to digitally scan in-office digital ear impressions efficiently and accurately. The innovation should include a means for a digital media management system for custom earplugs. Implementing these improvements will save the costs associated with physical ear canal impressions (material, shipping, handling, etc.). Further, the digital format for ear canal shapes will facilitate ongoing advancements in custom earplug designs (e.g., comfort versus noise attenuation, communication, in-ear active noise reduction) and population research studies of ear canal geometry (e.g. determine percent of population not suited for custom earplug use due to constructive ear canal geometry). Ear canal geometry should consider the need for (1) density imagery to map out underlying tissue, cartilage, and bone, and (2) modeling to predict where earplug girth would need to be changed to balance conflicting design goals of comfort, noise attenuation, and earplug retention in the ear canal. The proposed system should take into account: accuracy of ear canal measurements, ear mold manufacturing requirements, prototype cost, and practical feasibility of widespread dissemination of this capability to hearing health professionals.

PHASE I: Determine the feasibility of digitally scanning and recording ear canal shapes for custom earplug recipients.

PHASE II: Develop and demonstrate a prototype of the proposed system design including the software, hardware, and logistic components. Include estimates of the total cost of manufacturing the custom equipment.

PHASE III: Transition the technology to a DoD platform such as the Joint Strike Fighter.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Digital ear canal geometry impression scanning and digital file media management will be extremely beneficial to the hearing aid and industrial noise control industries.

REFERENCES:
1. Chester Pirzanski C, Berge B., “Ear Impressions Art or Science?” Audiology Online. March 18, 2002. http://www.audiologyonline.com/articles/article_detail.asp?article_id=336.

2. Cortez, R, Dinulescu N, Skafte K, Olson B, Keenan D, Kuk F., “Changing with the Times: Applying Digital Technology to Hearing Aid Shell Manufacturing” The Hearing Review. March 2004; 11(3):30-38.

3. Ingrao, B., “E-Business: Connecting Hearing Care Professionals and Their Suppliers.” The Hearing Review. August 2005; 12(9):18-22.

4. ANSI S12.6-1997, "Methods for measuring the Real-Ear Attenuation of Hearing Protectors".

5. "Bibliography on Hearing Protection, Hearing Conservation, and Aural Care, Hygiene and Physiology. 1831-1999," E-A-R 82-6/HP, E.H. Berger, M.S., January 25, 1999.

6. Kryter, K. “The Handbook of Hearing and the Effects of Noise” Academic Press, Inc.; 1994.

7. Berger, EG; Royster, LH; Royster, JD; Driscoll, DP; Layne, M. “The Noise Manual” Fifth Edition. American Industrial Hygiene Association, 2000.

KEYWORDS: Hearing; Conservation; Prevention; Scanning; Custom; Earplug.

N08-154 TITLE: Innovative Approaches for Evaluating Interlaminar Tensile Strength of Ceramic Matrix Composites (CMCs) at Elevated Temperatures

TECHNOLOGY AREAS: Air Platform, Materials/Processes

ACQUISITION PROGRAM: F35 - Joint Strike Fighter, ACAT I

OBJECTIVE: Develop and demonstrate interlaminar tension test methods for CMCs at high temperatures.

DESCRIPTION: The JSF and other military platforms are targeting CMCs for aero-engine applications in order to increase power. Concerns still exist regarding the degradation of CMCs at elevated temperatures due to life limiting phenomena. Currently, there are quite a few military handbook and American Society for Testing and Materials (ASTM) test standards for CMCs at both room and elevated temperatures, including interlaminar shear strength test methods [1-3]. However, there are no test methods in interlaminar tension for CMCs at high temperatures, primarily because it is extremely difficulty to develop appropriate high-temperature (up to 2300oF) adhesives between test coupons and push rods. Epoxy-type polymeric adhesives can be conveniently used in room-temperature interlaminar tension testing [4]; however, this is not the case for high temperatures. A new test method is required to evaluate material properties/affordability in interlaminar tension at elevated temperatures and establish design data. Development of this test is especially important because CMCs exhibit more inferior properties in interlaminar than in-plane directions due to their unique woven architectures. In many cases (e.g., airfoils) CMCs' interlaminar properties can be a design criterion/limit rather than a 'superior' in-plane property.

PHASE I: Determine the feasibility of developing high-temperature test methods in interlaminar tension. Demonstrate the feasibility by analytical method (e.g., finite element analysis) and by fabricating and testing preliminary test fixtures and test coupons at temperatures up to 2300oF in air.

PHASE II: Provide practical implementation of a pertinent test method to implement the approaches developed in Phase I. Evaluate the approach by conducting interlaminar tension testing utilizing a sufficient number of test coupons with different architectures of CMCs at temperatures up to 2300 oF in air. Also, show long-term (life limiting) test capability.

PHASE III: Transition the approach to JSF and additional propulsion applications.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: CMC propulsion components have a great potential to transition to civilian aero-engine applications. Development of the proposed test method would allow the complete evaluation of high-temperature interlaminar properties. The development also will provide national consensus on a test method for the military, ASTM, and/or ISO communities.

REFERENCES:
1. ASTM C 1292, “Test Method for Shear Strength of Continuous Fiber-Reinforced Advanced Ceramics at Ambient Temperatures,” Annual Book of ASTM Standards, Volume 15.01, ASTM, West Conshohocken, PA, 2007.

2. ASTM C 1425, “Test Method for Interlaminar Shear Strength of 1-D and 2-D Continuous Fiber-Reinforced Advanced Ceramics at Elevated Temperatures,” Annual Book of ASTM Standards, Volume 15.01, ASTM, West Conshohocken, PA, 2007.

3. MIL-HDBK-17-5, Ceramic Matrix Composites, 2002.

4. ASTM C 1468, “Test Method for Transthickness Tensile Strength of Continuous Fiber-Reinforced Advanced Ceramics at Ambient Temperature,” Annual Book of ASTM Standards, Volume 15.01, ASTM, West Conshohocken, PA, 2007.

KEYWORDS: Ceramic matrix composites (CMCs); interlaminar; tension test methods;elevated temperatures; test coupons; propulsion.

N08-155 TITLE: Real-time Spectral Band Optimization for Unmanned Aerial Systems (UAS) Hyperspectral Camera

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMA-264 - Air ASW Systems; PMA-290 - Maritime Patrol and Recon Aircraft

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop an integrated near real-time solution capable of determining the optimal multi-spectral bands for target detection, storing complete mission data, and parsing resultant data and metadata for transmission of hyperspectral imaging system.

DESCRIPTION: The current real time data transmission bandwidth of a hyperspectral imaging system exceeds the volume and weight allowance for data links on small tactical Unmanned Aerial Systems (UAS). This topic is designed to address the type and amount of data to be transferred to the ground control station in near real-time. It is desired that an automated analysis algorithm tune the hyperspectral output stream for optimum detection of specified target features in the given environment and store the complete data set for post mission analysis on the ground.

The complete system should be low power (<20W), lightweight (less than 4 pounds), robust and provide a high reliability of determining the correct transmission bands for desert, forest, and marine environments on board the UAS. The complete imaging system must be contained in a 4.75 inch diameter by 12 inch in length cylinder or smaller package. The imaging system is envisioned to be comprised of the hyperspectral camera, processing engine, and mass storage device. The existing data link presently handles 30 frames/sec video. A change may be suggested within the military approved operating bands and weight/volume constraints. The spectrum coverage desired is from 350nm to 1.7 micron, with automatic gain control, manual gain control (addressable), selectable bandwidth, feature extraction, and low power.

PHASE I: Determine feasibility of developing an innovative real time data transmission bandwidth of a hyperspectral imaging system. Perform design and analysis, define performance characteristics (including, but not limited to, spatial resolution, spectral resolution, spectral coverage, speed of operation, data transfer requirements, power consumption, and heat dissipation), develop the associated component level electronic circuits, optical configuration, and select the major components for proving the feasibility of the proposed system. Analyze all possible failure mechanisms and estimate sensor reliability, based on the performance of the electrical, optical, and mechanical subsystems.

PHASE II: Design and develop a full-scale prototype imaging system ready for UAS installation and conduct a land-based demonstration that illustrates system performance according to Phase 1 design.

PHASE III: Design and fabricate production prototypes for the Navy on board UAS. Transition technology to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The real-time optical band optimized system has the potential of being used by the merchant marine for surveillance and perimeter protection, local authorities for search and rescue operations, and the agriculture community for crop management.

REFERENCES:

1. Peter Bajcsy and Peter Groves, "Methodology for Hyperspectral Band Selection", Photogrammetric Engineering and Remote Sensing Journal, Vol. 70, Number 7, July 2004, pp. 793-802.
http://algdocs.ncsa.uiuc.edu/PB-20040701-1.pdf.

2. Steve De Backer, Pieter Kempeneers, Walter Debruyn and Paul Scheunders, "Band Selection for Hyperspectral Remote Sensing".
http://publications.vgt.vito.be/documents/PK/tgars2005.pdf.

KEYWORDS: Hyperspectral; Sensors; Micro Electro-Mechanical Systems; Signal Processing; Optics; IEDs.

N08-156 TITLE: W-Band Power Amplifier Based on Wide Bandgap Technology

TECHNOLOGY AREAS: Air Platform, Sensors, Electronics

ACQUISITION PROGRAM: PMA 261 H53 and PMA 275 V-22 Program Offices

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a state-of-the-art high power, highly linear, broadband, W-band solid state power amplifier utilizing wideband gap semiconductor device technology.

DESCRIPTION: Active antenna arrays and radar transmitters operating at W-band, especially 94 GHz, offer superior performance through clouds, fog, and smoke. Novel wide bandgap RF circuit technology is sought for radar operation at W-band in brownout and degraded visibility conditions. This need has led to interest in the development of W-band high power, high efficiency amplifiers. RF power amplifiers operating at W-band frequencies are currently realized almost exclusively in gallium arsenide (GaAs) and indium phosphide (InP) material systems due to their high transition frequency (Ft) performance. However, use of these devices has resulted in larger device peripheries for a given specified output power, more combining structures, higher combining losses, and lower power densities. These device technologies are not capable of meeting future peak power requirements. On the other hand, wide bandgap device technologies such as gallium nitride (GaN) can overcome these limitations as they can operate at higher voltages and have demonstrated power handling capabilities on the order 10x greater than that of GaAs or InP technologies. The goal of this topic is to develop a 94 GHz GaN device or unit cell, or circuit or microwave monolithic integrated circuit (MMIC). Demonstrate a single device or unit cell that outputs greater than 4 or 5 watts/mm and greater than 25% power added efficiency. Based on the device or unit cell performance, develop a 94 GHz GaN based high power amplifier circuit with the power output greater than 5 watts, gain greater than 25 dB, and 15% power added efficiency.

PHASE I: Demonstrate the feasibility through device simulation, analysis and/or device demonstration the capability to develop a 94 GHz device or unit cell that meets the objectives of this topic. Compare and contrast the gain, bandwidth, power, efficiency, and device architecture tradeoffs.

PHASE II: Demonstrate the feasibility through circuit simulation, analysis and/or circuit demonstration the capability to develop a circuit or MMIC architecture that meets the objectives of this topic. Compare and contrast the gain, bandwidth, power, efficiency, and device architecture tradeoffs. Develop the design criteria to address the thermal, electrical, and packaging challenges.

PHASE III: Demonstrate a fully functional W-Band power amplifier architecture utilizing power combining techniques to meet the platform radar or active antenna array requirements or performance objectives. Demonstrate power amplifier architecture electrical, mechanical and thermal in a relevant operational environment.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: W-Band gallium nitride (GaN) power amplifiers have potential commercial/dual-use applications in imaging for astronomy, security scanning systems to detect concealed objects for law enforcement, automotive radar collision avoidance systems, and high data rate wireless communication and networking systems/devices.

REFERENCES:
1. L. Marosi, M. Sholley, et al "94 GHz Power Amplifier using PHEMT Technology," Microwave Symposium Digest, 1995. IEEE MTT-S International, 16-20 May 1995 Page(s):1597 - 1600 vol.3.

2. Pin-Pin Huang; Tian-Wei Huang; et al.; Elliott, J.H, “A 94-GHz 0.35-W power amplifier module”, Microwave Theory and Techniques, IEEE Transactions on Volume 45, Issue 12, Part 2, Dec. 1997 Page(s):2418 – 2423.

KEYWORDS: Wide bandgap; power amplifier; millimeter wave; gallium nitride; brownout; aircraft.

N08-157 TITLE: <u>Helmet Mounted Display (HMD) Symbology for Rotocraft Degraded Visual Environments</u>

TECHNOLOGY AREAS: Air Platform, Human Systems

ACQUISITION PROGRAM: PMA-261, CH-53K Heavy Lift Helicopter Program, ACAT I

OBJECTIVE: Develop and integrate Helmet Mounted Display (HMD) symbology for both day and night operations to aid rotorcraft in brownout conditions and other degraded visual environments.

DESCRIPTION: Helmet Mounted Display (HMD) capability can enable rotorcraft pilots to remain “out of the cockpit” during day/night low/no visibility approach/landing operations, providing observation of the environment as conditions permit for better situational awareness. HMDs are expected to further reduce pilot workload and enhance performance. Critical to improving performance will be display symbology that provides high contrast against the background, with lower intensity and eye strain, particularly with night vision devices. This technology will have wide application across USMC, Navy, Army and Air Force rotorcraft fleets.

Innovative solutions to develop symbology for degraded visual environments that addresses the unique integration requirements of day and night HMDs are sought. A priority display is low speed symbology (velocity vector and acceleration cue) for brownout approach and landing. Near-term transition is expected to be to “clip-on” day HMDs and to Night Vision Goggles (NVGs). The symbology development cannot be practically segregated from the device technology due to issues of display imagery and symbology fields-of-view, display resolution, and appropriate background luminance/contrast and display gain/attenuation. Thus, the symbology development needs to be in the context of an integrated software/hardware system as designed for aviation degraded visual environments.

Although the focus is on relatively near team applications, compatibility of the technology with future color-capable visor/combiner displays would add value to the effort. Head-tracked symbology solutions are also not of immediate interest, but insights on extension of this technology would also add value to the effort.

PHASE I: Determine the feasibility of integrating symbology into a HMD and identify the steps needed to develop this technology for aviation applications, including both day and night devices. Recommend software and hardware architecture strategies, considering simple compatibility with existing aviation HMDs to a fully open systems architecture. Formulate baseline symbology and demonstrate suitability for day/night HMD displays.

PHASE II: Develop high contrast, high brightness symbology for day/night HMDs in a workstation/simulation environment. Integrate and demonstrate the symbology in prototype day and night HMD devices with suitably lighted backgrounds for day, night, and degraded visual environments.

PHASE III: Develop flightworthy day/night HMD software/hardware with symbology suitable for installation on a military helicopter. The system should provide standard HMD flight instrumentation as well as conventional low speed symbology. Perform incremental flight testing in order to evaluate the system in both day and night degraded visual environments and reduce risk.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology is applicable to all helicopter operations, both military and civilian. For example, helicopter operations that require flight in proximity to hazards or in degraded visual environments such as police operations, news agency operations, fire-fighting, off-shore oil platform operations, geological surveys, etc. would benefit.

REFERENCES:
1. SPIE 2001, “Luminance Contrast and Color Recognition in Helmet-Mounted Displays,” Havig, Grigsby, Heft, LaCreta, Post, Air Force Research Laboratory, WPAFB, OH 45433-7022.

2. SPIE 2002, “Luminance Contrast Requirements for Colored Symbols in Helmet-Mounted Displays,” Martinsen, Havig, Heft, LaCreta, and Post, Air Force Research Laboratory, WPAFB, OH 45433-7022.

3. SPIE 2004, “Effects of saturation contrast on color recognition in night vision goggles,” Havig, Marascoa, Posta, Ellwangera, and Reisba.

KEYWORDS: Symbology; Helmet Mounted Display; Degraded Visual Environments; Brownout; Day and Night; Helicopters.

N08-158 TITLE: Affordable, Lightweight, Universal, Linear Motion

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Aircraft Carriers, PMS 378 ACAT IV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The proposed topic intends to focus innovation to the controlled generation of linear motion/ force in an affordable, lightweight, universally applicable and easily integrated package. Linear electric motors have demonstrated great capability to enable improved shipboard machines including the ElectroMagnetic Aircraft Launch System (EMALS) and Advanced Weapons Elevator (AWE) programmed for CVN 78.   Concepts also exist for the internal movement of aircraft, weapons and stores with advanced linear motion, and for improving the cost, weight and maintenance of existing hull and deck machinery systems such as hatch covers and hangar doors. Weight and cost reduction targets of 20% or more each as compared to commercially available and legacy linear motion equipment, including linear electric motors, of equivalent power are desired. A lightweight, low profile, affordable, possibly modular, possibly portable device, or system that can be integrated with minimum impact to the ship for a wide range of applications requiring linear motion is the objective of this topic.

DESCRIPTION: A common motor, device, system or subsystem to generate linear motion/force for a variety of high capacity shipboard applications, that is shown to be lower cost and mass than equivalent commercially available equipment, is desired. The cost and weight of associated cooling systems, if required, must be included in the total for the system shown to result in a net savings. The system may be a modular, building block type design wherein one or more common units could be easily connected or otherwise combined to service a variety of applications, each of which requires a different force/stroke. Other concepts that enable the use of common, affordable, lightweight components for a variety of shipboard functions requiring linear motion are solicited. Simplicity and cost effectiveness of design, materials, manufacturing, set-up, installation, integration, operation and maintenance are key attributes, as is compliance with shock and EMI requirements. Also critical is integrated control or a design that is shown to be easily controllable from common, commercially available drives. Electric powered is encouraged, and hydraulic, steam and air powered is discouraged.

For the purposes of this research:
- Nominal peak motor thrust range: 5,000 LB (22kN) to 15,000 LB (67kN)
- Nominal continuous motor thrust range: 3,000 LB (11kN) to 12,000 LB (53kN)
- Variable velocity from 20 ft/min to 100 ft/min

PHASE I: Develop concept proposal for an affordable, lightweight, low volume, power dense, linear motion system that can be universally applied to service a variety of shipboard operations that require a broad range of force and stroke. Illustrate the ability of common components to meet widely disparate linear motion/force requirements while minimizing weight and volume. Conduct a study to illustrate conventional linear induction and linear synchronous motor design and associated cost and weight drivers compared with those of the proposed system. Also show comparison of the proposed system with more conventional linear motion equipment such as hydraulic, pneumatic and electro-mechanical machinery. Clearly articulate how cost, volume and weight savings are realized. Present findings with data, illustrations, related work, etc. to demonstrate feasibility of an affordable, lightweight, high capacity, universal linear motion system.

PHASE II: Design and develop two or more working prototype(s) that will be used to demonstrate feasibility of use with a variety of applications. Prototypes shall be full scale and power. Associated drives and control or other supporting equipment necessary for the prototype must be provided by the proposing small business. Demonstrate prototype in actual hardware tests with one or more machinery systems to be agreed upon and arranged with the TPOC. Additionally, conduct modeling and simulation of the prototype driving one or more alternate machinery systems. Further illustrate the universal applicability of the prototype using 3D modeling, drawings or actual demonstrations with photographs/video of the prototype integrated with a selection of disparate military and commercial machines and equipment with a broad range of force and stroke requiremts.

PHASE III: Partner with prime contractor/manufacturer. Conduct manufacturing engineering study to determine most cost effective production methods. Develop business plan to bring production units to military and commercial market. Produce necessary prototypes to drive a full scale machinery system such as the Navy Standard Elevator Land Based Engineering Site or other identified existing or developmental Naval machinery system(s). Integrate prototypes with test system and perform full spectrum of load cycle testing and endurance testing. Conduct environmental testing of prototype test articles including ship motion, shock and EMI. Develop integration plan for selected systems and ships. Seek other opportunities such as JCTD for joint application and resources.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Linear motion systems are in ever-increasing demand in many industries including shipbuilding, manufacturing, automation, material handling, transportation, aerospace and amusement industries. Accurate positioning of large, heavy parts in production lines or machines and equipment in the manufacturing process; large machine tool applications; as prime mover in warehouse material handling systems, airport baggage handling and aircraft cargo loading systems, vertically or horizontally sliding doors; propulsion of plant equipment, commercial passenger vehicles such as trains and city shuttle systems, amusement rides; and launching of aerial vehicles are all ideal applications for high capacity linear motion systems.

REFERENCES:
1. NAVSEA OP 3565/NAVAIR 16-1-529 Electromagnetic Radiation Hazards Vol. 2.

2. MIL-S-901D Shock Tests, high impact, Shipboard Machinery, Equipment and Systems, Requirements for.

3. www.dt.navy.mil/mac-res-eng/index.html

KEYWORDS: Linear; motion; affordable; universal; lightweight; machinery.

N08-159 TITLE: Eyesafer Fiber Laser Technology for Shipboard Defense

TECHNOLOGY AREAS: Electronics, Weapons

ACQUISITION PROGRAM: PMS 405 Laser Weapon System (fiber laser) Program. ACAT leve N/A

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop and evaluate an affordable design for a fiber laser and/or a fiber laser amplifier suitable for eventual military applications.

DESCRIPTION: The present technology of high-power fiber lasers is based on Yb-doped silica fibers, operating in the wavelength region around 1050 nm. Commercial, diffraction-limited, single-fiber devices with power levels of 3 kW are commercially available and higher-power devices at the 5-kW level are under development, for industrial applications such as cutting and welding. The high-power fiber-laser technology is of interest for the Navy in directed energy systems, but the wavelength of operation of Yb-doped fibers presents significant operational problems related to eye safety. Fiber lasers at wavelengths longer than 1400 nm have greatly reduced problems of eye safety, but development of kW-level and higher power lasers is well behind that of the Yb-doped systems. One important question is the ultimate limit to the single-fiber, diffraction-limited eyesafer sources, which may be, in some combination, due to optical damage, other nonlinear effects, or thermal effects. In some cases fundamental data to help determine these limits is lacking for the eyesafer wavelengths, and thus measurements are required. Once the limit is found, one can proceed to design a high-power system that can generate power at some safe fraction of the limit, and test the design through construction and operation of a sub-scale device. Both lasers per se, and laser amplifiers (broad band) are of interest.

PHASE I: Investigate the possible limits to the power output of diffraction-limited, single-fiber, eyesafer fiber lasers and laser amplifiers, through theoretical analysis as well as experiments to verify key parameters needed for the analysis. Develop a preliminary design for a high-power system that approaches these limits, and would be suited for military applications. Both single lasers as well as beam combining of broad band laser amplifiers should be addressed.

PHASE II: Utilize the findings established in Phase I to further develop a single-fiber, diffraction limited eyesafer fiber laser that produces power set only by the limits determined in Phase I. Conduct further experimental measurements of key fiber parameters as necessary. Design, build and deliver a credible, brassboard, sub-scale fiber laser that evaluates the design. This brassboard would be anticipated to deliver powers of the order of kilowatts.

PHASE III: Design, build and test a full-scale, eyesafer fiber-laser system brassboard to demonstrate that the design and subscale testing is valid. Deliver the system for testing with respect to effects and propagation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Many of the machining applications for high-power fiber lasers are wavelength insensitive and if the eyesafer fiber laser can ultimately produce higher powers than current Yb-doped, single-fiber, diffraction-limited systems, the technology developed can find uses in a number of industrial materials-processing applications. In addition, the longer wavelengths may be of use for some applications where the higher absorption of the materials to be processed is an advantage.

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KEYWORDS: Laser; fiber, high power, eyesafe, directed energy.

N08-160 TITLE: Micro-Lens Array Based Night Vision Optical Components

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Human Systems

ACQUISITION PROGRAM: PMS NSW Naval Special Warfare Visual Augmentation Systems (VAS) Program

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The objective of this Small Business Innovation Research (SBIR) topic is to investigate Micro-Lens Array (MLA) based optical components for Night Vision applications.

DESCRIPTION: Specifically, the goal is to develop and prototype MLA optical components such as Night Vision Goggle (NVG) eyepiece lenses and other optical components with the end goal of transitioning successful components to 40 degree Field of View (FOV) NVG and Wide FOV (WFOV) NVGs with approximately twice the horizontal FOV size. The benefits of this research are improved NVG performance, size, weight, and affordability. One of the key objectives is aimed at solving technical problems associated with WFOV NVG system designs. MLA technology may enable NVG eye box expansion without significantly increasing size and weight as with conventional optics. As an alternative for other conventional lenses, smaller size and lighter weight optical designs will reduce neck load on the NVG operator and associated neck injuries. Successful application of MLA based optical components will benefit Naval Special Warfare operators, Naval Aviators, Naval Surface Warfare personnel, and a wide-range of military personnel from all of the military services. For Naval and Marine Corps Aviators, benefits also include decreased risk of aircraft ejection injuries. MLA based components may also reduce the number of optical elements in some systems, which in turn could result in more affordable products.

The project requires MLA prototype components to be developed in phases with progressively more challenging requirements. The first phase includes proof of concept evaluation of off-the-shelf components and development of a concept for the first MLA prototype component for a night vision system. The second phase includes development and evaluation of prototypes for a traditional NVG device followed by development and evaluation of an MLA eyepiece component for a WFOV NVG. The third phase evaluates MLA components for production readiness in the U.S. Navy Transition Program(s). A wide range of additional transition programs are explored.

PHASE I: An optical component utilizing off-the-shelf MLA technology shall be prototyped and evaluated to proof the concept with success criteria based on the performance matching conventional optics while not distorting or creating image anomalies. Additionally, concept models shall be developed for an MLA-based Aviator Night Vision Imaging System (ANVIS) style eyepiece lens and 40 mm eye box (versus the current 25mm eye box). The goal for the concepts as compared to conventional NVG optics are to achieve equivalent or better performance, equivalent or smaller size, equivalent or lighter weight, while not distorting or creating image anomalies in the system.

PHASE II: MLA-based ANVIS style eyepiece lens and 40 mm eye box concept models shall be developed and evaluated to ensure equivalent performance with conventional optics. The goal for the MLA optical components as compared to conventional NVG optics are to achieve equivalent or better performance, equivalent or smaller size, equivalent or lighter weight, while not distorting or creating image anomalies in the system. Given successful demonstration and incorporation of lessons learned, a prototype eyepiece for a U.S. Navy WFOV NVG system shall be developed that doubles (threshold), quadruples (objective), or increases eye box size beyond a factor of four (as a stretch goal) relative to existing WFOV NVG eye box size. The goal is to significantly expand the exit pupil in an eyepiece lens without significantly increasing size or weight over conventional 25mm eye boxes. The goal for the final optical components as compared to using conventional optics are to achieve equivalent or better performance, smaller size, lighter weight, while not distorting or creating image anomalies in the system. Unclassified GFI will be provided to include U.S. Navy NVG technical data.

PHASE III: In Phase III, an MLA eyepiece demonstration model will be evaluated for production readiness into the transition program(s). The MLA based components shall meet the Transition Program expansion requirements of the exit pupil in the eyepiece lens without significantly increasing size or weight nor distorting or creating image anomalies in the system. Unclassified GFI will be provided to include U.S. Navy NVG technical data. The anticipated transition of the technology is to make innovative MLA based optical components commercially available to WFOV NVG manufacturers enabling partnerships to successfully integrate MLA based components into the U.S. Navy Transition Program(s). Additional applications of the MLA technology will be evaluated including optical components for other Naval Special Warfare NVGs and WFOV systems, Naval Aviator Night Vision Imaging Systems, Joint programs, Naval Surface Warfare applications, and a wide-range of applications in the U.S. Marine Corps, U.S. Army, U.S. Air Force, and U.S. Department of Homeland Security.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Private Industry uses MLA technology for commercial products and can benefit from this research in applying resulting concepts to develop less expensive, smaller, and lighter optical components for commercial products. Night Vision devices and other electro-optical and infrared systems are used extensively in the commercial sector to include law enforcement, security, etc. This topic has a wide range of commercial applications.

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2. Tanida, J. et. al. "Thin observation module by bound optics (TOMBO): concept and experimental verification." Applied Optics, Vol. 40, No. 11, April 2001, pages 1806-1813.

3. Andersen, R.H. "Close-up imaging of documents and displays with lens arrays." Applied Optics, Vol. 18, No. 4, Febuary 1979, pages 477-484.

4. Gregory R. Brady, “Design and fabrication of refractive microlenses,” Thesis submitted to Department of Electrical and Computer Engineering at McGill University, Montreal, Canada, July, 2000.

KEYWORDS: Micro-Lens Array (MLA); Optics; Wide Field of View (WFOV), Night Vision Goggle (NVG), Electro-Optic (EO); Image Intensification.

N08-161 TITLE: Foveal Imaging Night Vision System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Human Systems

ACQUISITION PROGRAM: PMS NSW Naval Special Warfare Visual Augmentation Systems (VAS) Program

OBJECTIVE: The objective of this Small Business Innovation Research (SBIR) topic is to investigate applications of foveal imaging for night vision systems by developing an imaging system that maintains high resolution in the center and trades resolution away from the center with an increased field of view.

DESCRIPTION: The goal is to develop concepts and prototype a system with a wide angle foveal imaging capability that increases the field of view over existing standard optical designs. Standard Night Vision Goggle (NVG) designs have a field of view of 40 degrees and a resolution of 1 to 1.3 cycles/mrad across the entire field of view. The field of view of the foveal imaging system should be a minimum of 80 degrees. The image displayed to the eye shall have little or no distortion.

The benefits of this research are improved NVG field of view. One of the key objectives is aimed at solving technical problems associated with WFOV NVG system designs. This capability will result in improved performance by increasing the situational awareness associated with the wider field of view.

The project requires a Wide Angle Foveal system to be investigated through development of creative optical systems, sensor configurations, image processing or any combination of these elements. The first phase includes an engineering analysis and prototype or model of the design. The product should incorporate an imaging component (optical), a low light sensor (image tube or intensified low light level imager), and a display for handheld or helmet mounted applications. The second phase includes the development of a prototype for evaluation in an operational environment. The third phase incorporates the foveal imager concept into a U.S. Navy system along with test and evaluation for production readiness into the transition program. A wide range of additional transition programs are explored.

PHASE I: A concept for a foveal imager with low distortion and field of view of 80 degrees or more shall be developed. The imager concept shall include all components necessary for handheld or helmet mounted use including consideration of tradeoffs including light weight, low power and small size.

PHASE II: A demonstration system shall be developed for concept evaluation. The system shall be suitable for demonstration purposes in an outdoor operational environment and be battery operated. The system should demonstrate a wide field of view capability in a compact assembly which will demonstrate the ability to transition to a small portable system.

PHASE III: In Phase III, the small business will produce developmental systems to be used for operational test and evaluation. The system produced will be evaluated for transition to military night vision goggle programs. Additional applications of the Wide Angle Foveal technology may include vehicle navigation, wide area surveillance and tracking, handheld and head mounted visual augmentation systems used by Naval Special Warfare, U.S. Marine Corps, U.S. Army, U.S. Air Force, and U.S. Department of Homeland Security.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Private Industry uses wide angle foveal imaging technology for applications including law enforcement, commercial security and surveillance, robotic navigation, home security and similar commercial products can benefit from this research in applying resulting concepts to develop wide angle visual systems.

REFERENCES:
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2. K. Wakamiya, T. Senga, K. Isagi, N. Yamamura, and Y. Ushio Nikon Corp. (Japan), "A new foveated wide angle lens with high resolving power and without brightness loss in the periphery," Proceedings of SPIE, Volume 6051 (Optomechatronic Machine Vision), Kazuhiko Sumi, Editor, 605107 (Dec. 5, 2005).

3. "FOVEATED WIDE-ANGLE IMAGING SYSTEM AND METHOD FOR CAPTURING AND VIEWING WIDE-ANGLE IMAGES IN REAL TIME" United States Patent 20060209194, Abstract: A foveated wide-angle imaging system and method for capturing a wide-angle image and for viewing the captured wide-angle image in real time. In general, the foveated wide-angle imaging system includes a foveated wide-angle camera system having multiple cameras for capturing a scene and outputting raw output images, a foveated wide-angle stitching system for generating a stitch table, and a real-time wide-angle image correction system that creates a composed warp table from the stitch table and processes the raw output images using the composed warp table to correct distortion and perception problems. The foveated wide-angle imaging method includes using a foveated wide-angle camera system to capture a plurality of raw output images, generating a composed warp table, and processing the plurality of raw output images using the composed warp table to generate a corrected wide-angle image for viewing.

4: S. Kleinfelder, “Foveated Imaging on a Smart Focal Plane.”
Web Address1: http://scien.stanford.edu/class/psych221/projects/99/stuartk/fovis.html.

KEYWORDS: Wide Angle Foveal (WAF); Optics; Electro-Optic (EO); Infrared (IR); Wide Field of View (WFOV); Night Vision Goggle (NVG).

N08-162 TITLE: High-Quantum-Efficiency Photocathode Development

TECHNOLOGY AREAS: Ground/Sea Vehicles, Weapons

ACQUISITION PROGRAM: PMS 405

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: To develop the manufacturing methodology and techniques for the production of high-quantum-efficiency photocathode devices that meet Free Electron Laser (FEL) weapon performance requirements and affordability criteria. This will require the transition from table-top, one of a kind construction to well defined fabrication procedures.

DESCRIPTION: Free Electron Lasers (FELs) are the present high-power directed energy weapon (DEW) of choice for the Navy. Effective FEL weapon injectors require high-average-current photocathodes that deliver CW average Ampere-level currents. These cathodes must be robust and stable with lifetimes exceeding 100 Amp-hours. Weapon system cathodes must consistently produce > 5% quantum efficiency (QE) with green illumination for the entire cathode lifetime. Current density and pulse format are also important parameters for these devices. A cathode that has high current density and can be gated at high frequency enables greater flexibility and enhanced performance. Present fabrication techniques are inadequate to deliver the required specifications. Hence affordable cathodes (as defined by the capital and operational cost of the associated photocathode drive laser system and the operational cost associated with cathode lifetime, performance, reliability and replacement) do not presently exist for FEL weapons. The objective of the present program is to rectify this shortfall in performance and affordability. Ultimately, the final choice of cathode technology may well depend upon its manufacturability.

PHASE I: Under Phase I of the SBIR the contractor shall:
- select one or more high-quantum-efficiency cathode technologies for study.
(Concepts could include but are not limited to multi-alkali cathode materials, dispenser and diamond amplifier devices, as well as GaAs and GaN semiconductors.)
- conduct an investigation to determine the feasibility of reliable production of the selected cathode(s) and justify how the required performance and affordability will be achieved.
- develop a preliminary process flow and fabrication plans.

PHASE II: Under Phase II the contractor shall:
- produce prototype cathodes and evaluate them for reliability.
- demonstrate performance consistent with cathode performance requirements and affordability criteria.
- fully develop and demonstrate a reliable and robust fabrication procedure.

PHASE III: Under a Phase III program, the contract shall:
- manufacture cathodes for integrated electron injector system evaluation.
- specifically, cathodes shall be capable of insertion into an operational high-current electron source to demonstrate consistent achievement of required performance and lifetime specifications.
- demonstrate that the manufacturing processes developed and performance achieved meet the defined affordability criteria.
Access to a suitable electron injector will be provided as GFE to the contractor by the Navy FEL Innovative Naval Prototype Program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: High-QE photocathodes are equally sought after in the private sector.

Photocathode electron injectors can be found in numerous Universities and R&D Institutions worldwide. An affordable, higher performance photocathode concept would find immediate application as a replacement cathode at all these institutions. Specific high impact examples include the many light sources (40 intense synchrotron light sources worldwide) that are used for commercial development and the next generation of energy recovery linac (ERL) light sources that are presently on the drawing boards.
In a more speculative context, if the cost can be driven low enough and the quantum efficiency high enough (>20%) then the manufactured device might be suitable for use in photomultiplier tubes which represent a very large commercial market. One cathode concept has been suggested as the source for a so-called "lasertron" which can be considered as an Inductive Output Tube (IOT) with very high efficiency. Carrying this concept further, one can envision operating such a high-current density, high-gain cathode in a thermionic mode at which point the applicability within the enormous vacuum electronic tube industry opens up. Not only would improved vacuum electronic tubes benefit the broadcasting and transportation industries (via radar systems) but would come full circle to again benefit DOD where they are widely used.

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2. X.Y. Chang, I. Ben-Zvi, A. Burrill, P.D.J. Johnson, J. Kewisch, T. Rao, Z. Segalov, Y. Zhao, "Study of Secondary Emission Enhanced Photoinjector", http://accelconf.web.cern.ch/accelconf/p05/PAPERS/TPPE042.PDF

3. Norton, T. J., Woodgate, B. E., Stock, J., Hilton, G., Ulmer, M. P., Aslam, S., Vispute, R. D. "Results from Cs activated GaN photocathode development for MCP detector systems at NASA GSFC" Proc. of SPIE, 5164, 155 (2003).

4. Brookhaven National Laboratory (United States Patent Application 20070181833 Kind Code A1 Srinivasan-Rao; Triveni ; et al. August 9, 2007).
KEYWORDS: Photocathode; High-Quantum-Efficiency; Long Lifetime; High-Current-Density; Free Electron Laser; Electron Injector

N08-163 TITLE: Improved Extrusion and Milling Techniques

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: Architectures, Interfaces and Modular Systems (AIMS)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a manufacturing technique that will increase rate and quality of production for an irregularly shaped, high tensile strength extruded aluminum track used in the FlexTech Track System.

DESCRIPTION: The FlexTech track system is constructed of an aluminum alloy through extrusion techniques. However, the strength of the alloy and configuration of the design increases the difficulty of extruding long runs of the track. The cost of extrusion equipment is significant, so the recapitalization of existing machinery in the proposed manufacturing technique would be more likely to be commercialized into metal working facilities. An innovative manufacturing technique is needed to mass produce this track to keep the tolerances within acceptable limits. Improved manufacturability of the FlexTech product would enable advancement of a concept which seeks to extend a ships useful service life.

The track has undergone extensive redevelopment to facilitate improved production quality. Advancements in track design would be considered to increase the probability of success.

FlexTech is a slot and hole configuration track system for holding equipment to the deck or bulkhead depending on the application. This permits the securing of heavy equipment within ship spaces without welding. The FlexTech Modular Track system is used to enable modularity and open architecture in new ship construction. Modularity and open architecture is a leading approach in the effort to create reconfigurable work spaces aboard ships.

The worlds dynamic geo-political environment causes modern ships to be outmoded too quickly to keep up with the pace of change. Reconfigurable spaces will allow changes to ship functionality over the useful service life. A ship outfitted with FlexTech will be a reconfigurable open system. By enabling the rapid change of ship spaces, ship lifecycles can be extended significantly.

PHASE I: Develop the proposed concept into a feasible manufacturing technique which supports the topic objective.

Upon completion of the Phase I effort, a well-reasoned evaluation of the concepts and methods necessary to mass produce a quality track that meets tolerance limits would be expected. Investigate processes to determine the technical feasibility of an advanced manufacturing concept based in part on modern metal extrusion techniques that can be used to manufacture the FlexTech Track System.

PHASE II: Conduct necessary Research and Development to advance concept. Field a working prototype to evaluate the manufacturing technique.

To improve the probability of success in the new manufacturing technique some redesign of the track system may be considered. Based on current practices, develop an advanced manufacturing technique. The technique must meet approved tolerances for the track design and installation. In addition, the extrusion technique should be make use of existing extrusion machinery so that cost is kept to a minimum.

PHASE III: Conduct qualification testing. The expected end-state will be Government purchase of FlexTech from the steel and ship building industries. The manufacturer of FlexTech will be the customer for the new manufacturing technique. The completed project should be commercialized to the defense and manufacturing industries to facilitate production of the FlexTech Track System.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Reconfigurable spaces are primarily applicable to warships which experience regular upgrades in mission technologies. However, the commercial shipping industry may also find benefit in the ability to modify payload spaces in order to adjust to evolving cargo and seasonal route changes.

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2. A. K. Sheikh and S. Z. Qamar. "A study of die failure mechanisms in aluminum extrusion." Journal of Materials Processing Technology Volume 134, Issue 3 20 March 2003, Pages 318-328.

3. A. K. Sheikh, A. F. M. Arif and S. Z. Qamar. "A probabilistic study of failures of solid and hollow dies in hot aluminum extrusion." Journal of Materials Processing Technology, 30 November 2004, Pages 1740-1748.

4. J. Phillips, T. Esposito. "Near-Net Extrusion: An Ideal Manufacturing Process for High - Strength Titanium Aerospace Components".

5. I. Gheorghe, Alu Menziken. "Latest Alloy Development Activities at Universal Alloy Corporation." UAC, Canton, GA.

KEYWORDS: Extrusion, high tensile strength, aluminum, open systems, open architecture.

N08-164 TITLE: <u>Innovative Wide Bandgap Accelerated Life Test and Reliability Prediction</u>

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: This topic seeks to significantly improve Wide Bandgap (WBG) Device and Component accelerated reliability test methodologies over the current State of the Art. Existing accelerated reliability test equipment utilized at government and contractor facilities have significant limitations in measuring junction temperatures accurately and maintaining accurate test power conditions. The inherent limitations of the test equipment in monitoring the actual junction temperatures of all test devices/components within test runs leads to variability in the reliability data that is obtained. This variability results in large error brackets on obtained test data and on the calculated activation energy values used to predict lifetimes for the device/components. The uncertainty of the junction temperatures and resulting lifetime estimates leads to program insertion risk in fielding high power WBG device/component technologies; it also leads to increased system logistics costs. Current life test stations have limited to no error bracket data available on reliability test data being generated and lifetime prediction uncertainty. This project would seek to understand current system error brackets and data limitations and to define innovatiive equipment and test protocols to significantly improve accelerated RF WBG life testing and reliability predictions.

DESCRIPTION: High power radar and EW modules are required for Electronically Scanned Arrays (ESA) to provide significant system performance improvements. These modules from a system perspective are a major portion of the system cost and they provide thermal and reliability challenges to designers and manufacturers that must be over come to provide effective ESA solutions.

The state of the art for Wide BandGap(WBG) device/component reliability testing and device life predication is currently limited by the accuracy that the device/component junction temperatures can be determined, monitored and controlled during accelerated life stress tests, The intrinsically robust nature of the WBG device materials makes accelerated testing using traditional test equipment and test methods more difficult and test time durations that are costly. The robust nature of wide bandgap materials requires testing to be conducted at higher temperatures to accelerate failure mechanisms to occur within realistic test times. The higher thermal conductivity of the WBG materials also makes junction temperature measurement within the complex fixturing required for RF stress testing difficult. Typically, temperature monitoring and measurement are taken at known locations on the device/component test assembly and junction temperatures are calculated from this known temperature reading using computer models that extrapolate to obtain the actual junction temperature. This leads to large error brackets on the obtained junction temperature data, errors in prediction of activation energies and extrapolated Arrhenius life times. System impacts from these test/data limitations and errors can lead to significantly higher cost systems, logistics and reliability issues as well.

The above issues, lead to significant reliability test data error-brackets and variability in life time predictions. Innovative technologies are sought that 1) improve accelerated life test equipment and fixturing with increased test range (higher temperatures >400 C), and 2) improve junction temperature identification through in situ measurement, measurement/modeling procedure standardization and or methodologies to increase reliability test data range and extrapolation are sought. It will be important that any proposed solution shall significantly improve the state of the art for WBG reliability tests and that lifetime prediction data error brackets be minimized.

PHASE I: Identify, model and demonstrate innovative material, design, process and testing technologies that significantly improve reliability test equipment performance range and accuracy. This should include equipment improvements, test procedure standardization/improvement and/or improved device junction temperature measurement or calculation.

PHASE II: Develop and demonstrate a prototype test station and test procedures for high power wide bandgap devices/components of interest to the government, and deliver a prototype test station to the government. The prototype equipment and processes developed should have dual use application and commercial applications.

PHASE III: Transition developed technologies, utilize technology developed on transition system insertion modules and demonstrate performance, reliability and cost benefits shall be identified.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Wide Bandgap semiconductors are being developed for commercial and military RF and power applications, these components are enabling higher performance ESA for EW and Radar and they would find numerous applications in military systems as well as commercial systems for transportation radar systems.

REFERENCES:

1. "DARPA Wide-Band-Gap Semiconductors for rf Applications (WBGS-RF) Tri-Service Reliability Testing", S. C. Binari and J. Roussos Naval Research Laboratory, Washington, DC; G. D. Via Air Force Research Laboratory, Dayton, OH; E. Viveiros Army Research Laboratory, Adelphi, MD, presented at GOMACTech-06.

2. www.darpa.mil/MTO/Programs/wbgsrf/pdf/RFIC.pdf

3. www.gaasmantech.org/Digests/2005/2005papers/1.2.pdf

KEYWORDS: ESA; Radar;EW;Bandgap; Accelerated Test; Reliability

N08-165 TITLE: Processing Signals In High Density Electromagnetic Environments

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PEO IWS 1.0, PEO IWS 2.0

OBJECTIVE: Research and develop improved processing technology that will allow for the processing of signals of interest in the simultaneous presences of high powered, in band emissions from onboard radiators. These techniques may require specific new hardware configurations, but the hardware itself must be within current receiver capabilities. The addition of a resource manager that can direct the tuning of narrow and wideband filters in the EW receiver is one of the approaches that may be considered. Current technology will allow up to ~20ms prior knowledge of radar transmission parameters.

DESCRIPTION: Navy ships employ a number of high powered, high duty cycle RF emitters in order to fulfill their missions. They also employ high sensitivity receivers to detect, identify, and track other platforms. This function is also necessary in order to fulfill their mission. A serious problem arises when these functions are required to operate simultaneously. The receivers can not process both the week signal they are required to detect at the same time these high powered emitters are transmitting. The reason being that the signal of interest may have a received power on the order of -80 dBm but the received power from the on board emitter may be +40 dBm or more. To fully function in this environment the instantaneous dynamic range of the receiver must be at least 120dB. This is beyond current receiver technology. Various methods are currently used to mitigate this problem. In the case where the interfering signal is at a frequency other than the signal of interest filters or channelized receivers can be used to eliminate the interference. When both signals are in the same band of the receiver, then blanking may be used. The problem with these methods is that the bands of frequencies that are blanked or filtered are no longer available to detect signals of interest that may be within these bands.

PHASE I: The awardee shall research and identify technologies and processing algorithms that effectively increase the effective dynamic range of a receiver and/or mitigate the blinding effects of simultaneous in band high power emitters. The awardee shall research and identify their approach, document all requirements, both hardware and software, and provide an outline of the model and code for any processing algorithms. These techniques may require specific hardware configurations, e.g., setting adjacent channels of a channelized receive to the same frequency but different detection thresholds; addition of dynamic filters to the front end of the receiving antenna; or the addition of processing hardware to characterize the known signal (on board emitter) so as to identify it and separate it from the signal of interest. On going work in the development of miniature fast tuning, adjustable bandwidth and adjustable attenuation filters may also be applicable to this task. Past efforts in detecting signals with very low S/N may be applicable to this problem. In particular, techniques based on, correlation, HOSP (Higher-Order Spectral Processing), and ICA (Independent Component Analysis),and cepstral separation in the time domain.

PHASE II: The awardee shall develop, document, and code the algorithm(s) as described above. All products shall be tested and validated. Documentation shall be of a level of detail for eventual incorporation into SEWIP Block 2 specifications.

PHASE III: The awardee shall refine the algorithm(s) as required and participate in the efforts to field these capabilities to the fleet.

PRIVATE SECTOR COMMERCIAL POTENTIAL: Reduction of interference for commercial RF communications.

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1. "Adaptive Blind Signal and Imagine Processing", A. Cichocki. Amari, 2002.

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4. "Zero-Order Statistics: A Signal Processing Framework for Very Impulsive Processes", J. G. Gonzalez/ D.W. Griffith/ G. R. Arce. NSF Grant MIP-9530923 ATIRP CA No. DAAL01-96-2-0002, 1996.

5. "Higher-Order Spectra Analysis", C. L. Nikias/A. P. Petropulu , 1993.

6. "Microwave Frequency Selective Limiters", Padisan Phudpong and Ian C. Hunter, Institute of Microwaves and Photonics, School of Electronic and Electrical Engineering, University of Leeds, Leeds, LS2 9JT, UK.

7. "Perfectly-Matched Bandstop Filters using Lossy Resonators", Andrew C. Guyette, Ian C. Hunter, Roger D. Pollard and Douglas R. Jachowski, Institute of Microwaves and Photonics, School of Electronic and Electrical Engineering, University of Leeds, Leeds, LS2 9JT, UK, Microwave Technology Branch, Electronics Science and Technology Division, Naval Research Laboratory, Washington, DC 20375.

8. "Compact, Frequency-Agile, Absorptive Bandstop Filters", Douglas R. Jachowski, Microwave Technology Branch, Electronics Science and Technology Division, Naval Research Laboratory, Washington, DC 20375.

9. "Spontaneous and Explicit Estimation of Time Delays in the Absence/Presence of Multipath Propagation", Hing Cheung So, The Chinese University of Hong Kong, 1995.

There are no SEWIP Block 2 references available at this time.

KEYWORDS: electronic warfare; open architecture; softkill; combat system; algorithm; EMI; EMC

N08-166 TITLE: Tools to Support Understanding of Information Uncertainty in Combat Operations

TECHNOLOGY AREAS: Information Systems, Battlespace, Human Systems

ACQUISITION PROGRAM: Aegis Modernization Program, DDG 1000, CVN 21, LCS, TSTS

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The objective is to identify and develop strategies and interface tools for effective portrayals of uncertainty and information reliability.

DESCRIPTION: In military operations and training, adequate understanding of battlespace events can be critical to mission planning and execution success. However, because uncertainty is inherent in all military operations including warfighter competencies, information pertaining to the degree of certainty or reliability in data is necessary to develop accurate situational understanding. Ultimately, inadequate representation of information certainty can lead to sub-optimal or delayed decisions, resulting in loss of momentum or diminished tactical advantage. Strategies and interface tools are needed that provide validated, effective information representations of uncertainty and information reliability as an integral part of the warfighter interface in future combat systems in order to maintain information dominance and facilitate timely, decisive action in combat. Currently, there are few tools and strategies to support the commander in understanding either the reliability of the data or the criticality of missing data. Due to these short-comings, either the warfighter's situation awareness is degraded, leading to sub-optimal decisions, or the decision process is delayed, resulting in loss of momentum or tactical advantage. Effective techniques are needed to convey information uncertainty such that it is intuitively grasped by combat decision-makers.

PHASE I: This effort shall provide the design and demonstration of methods, strategies, or tools for portraying information certainty and reliability in the context of combat systems and training operations. Appropriate methods for assessing the benefit of information representations shall be evaluated and documented (e.g., reduced situation awareness errors, faster decision making, increase semantic value of data portrayals, etc.).

PHASE II: This effort shall develop a prototype tool for a comprehensive information uncertainty visualization system for the warfighter, including tools for supporting the warfighter in perceiving, correlating, and evaluating data uncertainty and reliability for combat decision making. The phase II shall include an evaluation of candidate information portrayal strategies, and the development of a standardized coding for battlespace information.

PHASE III: The efforts include transitioning the prototype (strategies, tools, and warfighter interface components) developed for Naval Combat Systems to an additional operational and training domains. This effort would require analysis of the new domains to define elements of operations impacted by uncertainty and identify sources of uncertainty to be addressed.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The methods and strategies developed here for representing data uncertainty and reliability have potential application and commercial value to the finance industry for risk management and effective projections for investment. Information visualizations of uncertainty would also be of benefit to meteorological and oceanographic scientists who utilize multiple data sources with varying capabilities and levels of reliability for mapping of Earth-surface activity. Additional application areas include joint military operations, weather forecasting and homeland defense.

REFERENCES:
1. Banbury, S., Selcon, S., Endsley, M., Gorton, T., & Tatlock, K. (1998). Being certain about uncertainty: How the representation of system reliability affects pilot decision making. Paper presented at the Human Factors and Ergonomics Society 42nd Annual Meeting, Santa Monica, CA.

2. Endsley, M. R., Bolte, B., & Jones, D. G. (2003). Designing for situation awareness: An approach to user-centered design. London: Taylor and Francis.

3. Andre, A. D., & Cutler, H. A. (1998). Displaying uncertainty in advanced navigation systems. Paper presented at the Human Factors and Ergonomics Society 42nd Annual Meeting, Santa Monica, CA.

4. Tufte, E. R. (1990). Envisioning Information. Cheshire, Connecticut: Graphics Press. Zhang, J., Johnson, K. A., Malin, J., & Smith, J. W. (2002, July 18-19, 2002). Human-centered information visualization. Paper presented at the International Workshop on Dynamic Visualization and Learning, Tubingen, Germany.

KEYWORDS: Information Uncertainty, Situation Awareness, Data Visualization, Decision Making.

N08-167 TITLE: Innovative Electronically Scanned Array RF-Photonic Architectures, Components and Sensors

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Numerous tactical systems are developing that employ Electronically Scanned Array (ESA) technologies that have severe performance design constraints such as system performance, weight, size, cost, power consumption as well as functioning properly during hostile or friendly exposure. RF-Photonic technologies are being developed for the Telecom industry as well as high performance technologies being established by DARPA and ONR. Innovative concepts that propose Architectures for waveform/signal generation, true-time-delay (TTD) beamforming, signal distribution and sensor applications that improve system performance or system test are sought. The architectures should focus on Navy system insertion targets and the proposed approach shall evaluate and identify how the architecture, components, links and sensors being developed will be robust enough to function under the environmental constraints of military systems as well as reducing weight, size, power consumption, thermal management and interconnectivity of existing hardware used in the system.

DESCRIPTION: Current generation ESA architectures have large numbers of elements and associated power, weight, size and interconnectivity. RF-Photonic components and links used in commercial telecom systems and the ONR/DARPA initiatives to establish high performance RF-Photonic components can be utilized in waveform/signal generation, TTD beamforming and signal distribution to significantly increase the performance of ESAs. Such ESAs would exhibit lower susceptibility to electromagnetic interference, and the power, thermal dissipation, interconnects, size and weight can be decreased by > 2X.

The intended proposals will define architectures that are focused on existing or contemplated Navy ESAs or systems. The viability of the architecture performance and its ability to provide system performance improvements of > 2X as identified above as well as assessment of the robustness of the technologies proposed to meet the environmental and operational of their intended application.

PHASE I: Perform a feasibility study for an innovative architecture, component and/or sensor. This initial development effort should demonstrate a photonic circuit concept capable of providing increased radar performance with 2X reduction in size, weight, power and thermal dissipation that is robust enough to meet Navy application temperature ranges and environmental specifications for the system that this architecture is targeting for transition. Project risk and technology development needed is to be defined during the Phase I study.

PHASE II: Develop a prototype photonic circuit, architecture, component and/or sensor. Demonstrate the performance increase provided by the hardware over the current radar technology performance with 2X reduction in size, weight, power and thermal dissipation that is robust enough to meet Navy application temperature ranges and environmental specifications.

PHASE III: Production of robust, application-ready, photonic interconnections, components and subsystem to transition into the Navy ESA systems that the proposal targets. Construct and demonstrate photonic technologies that are suitable for system insertion both through improved system performance parameters and capable of operating in application temperature ranges and environmental conditions.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Photonic interconnections, components, sensors and subsystems enabling higher performance ESA would find numerous applications in military systems as well as commercial systems for transportation systems.

REFERENCES:

1. M.W. Beranek, "Fiber optic interconnect and optoelectronic packaging challenges for future generation avionics," Proceedings of SPIE, vol. 6478, 2007.

2. http://www.darpa.mil/mto/programs/aosp/pdf/pappert.pdf

3. http://www.darpa.mil/mto/programs/aosp/pdf/goutzalis.pdf

KEYWORDS: ESA, Radar, EW, RF-Photonic, sensor, test.

N08-168 TITLE: Improved Contact Association

TECHNOLOGY AREAS: Information Systems, Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS IWS5E Undersea Warfare – Decision Support Systems, ACAT II

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The objective of this work is to improve surface ship undersea warfare scene management by improving the association of track and feature data between sensors and sensing platforms.

DESCRIPTION: Association of non-commensurate or dissimilar data from different sensor types is traditionally performed using kinematic attributes such as position, speed, bearing, and bearing-rate. In contact rich environments however, association ambiguities may not be completely resolved by kinematics alone – resulting in a higher probability of miss-associated tracks, and a poorer understanding of the contact scene by the Navy operator. The challenges are greater still when attempting to associate latent, old, and non-overlapping (temporally or spatially) data from multiple-platforms over large geographic areas. The inclusion of non-commensurate features, such as radar cross-section, passive acoustic signatures, active acoustic features, electro-optic, infrared, and others, holds the promise of reducing the probability of miss-association of contact tracks in US Navy combat systems. It would also provide the data required for improved threat assessment and contact prioritization. Identification of the appropriate features, and the development of an algorithm for non-commensurate feature association are required.

PHASE I: Develop a mathematically rigorous algorithm for non-commensurate track and feature association. Identify the relevant and unique contact features that are available from USW sensors and platforms, or could potentially be made available for non-commensurate track and feature association. Provide a demonstration of the approach using real or simulated data.

PHASE II: Develop a real-time R&D software prototype of the non-commensurate track and feature association algorithm. Identify multi-sensor features for contact-of-interest and interferer contact classes and develop a method for optimal selection of these features for use in the association algorithm. Demonstrate the ability of this prototype system to improve contact data association as compared to a method based solely on kinematic features. Evaluate the performance improvement using quantitative measures of performance.

PHASE III: Integrate the software into a US Navy ASW combat system. Demonstrate and document performance measured during at-sea trials.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Improved contact association is critical to automation of security systems used in a variety of surveillance applications, such as building, facility, and port security. With the increased emphasis on homeland security, this has become a multi-billion dollar industry, annually.

REFERENCES:

1. “Features for Track Association,” Bogner, R.E. Signal Processing and Its Applications, 1996. ISSPA 96, Fourth International Symposium on Volume 1, Issue , 25-30 Aug 1996 Page(s):131 - 133.

2. “Track-to-track association for tracks with features and attributes: Sensor bias estimation from measurements of targets with known deterministic dynamics.” Edited by Burns, Paul; Blair, William D. Proceedings of the SPIE, Volume 5913, pp. 374-385 (2005).

3. “Estimation with Applications to Tracking and Navigation: Algorithms and Software for Information Extraction” (Wiley, 2001) by Y. Bar-Shalom, X. R. Li and T. Kirubarajan.

4. “Handbook of Multi-Sensor Data Fusion”, 2001 CRC Press, Dr. David Hall & Dr. James Llinas.

KEYWORDS: Multi sensor, multi platform, contact association.

N08-169 TITLE: Radar Power Sources and Power Conditioning

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PEO IWS 2.0, Major Program Manager, Above Water Sensors, Captain Lawrence C

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Design and develop low-cost, high efficiency, high power density, fast transient response, DC/DC converters with low output capacitance for pulsed current loads supporting high power radar applications.

DESCRIPTION: Higher peak and average power levels of future Navy active array radar systems require significant advancement in technologies to achieve reductions in antenna weight, size, and cost while providing significantly higher power per unit volume than present commercial technologies. Future requirements are expected to stress fast transient response, isolated DC/DC converters for pulsed current loads while minimizing output voltage bulk storage capacitor requirements. Advancements are required in the development of power conversion technologies and assemblies including isolated DC/DC converters with significantly lower noise, cost, and weight, fast transient response, low overshoot and output voltage droop, higher efficiency, and higher power density. Goals for the fast transient response 300V input, 28V output isolated DC/DC converter include output power greater than 1kW, efficiency greater than 90 percent, power density greater than 200W per cubic inch, response time less than 10 microsecond, settling time less than 10 microseconds, overshoot less than 4 percent, base plate temperature 70C, and thickness less than 10mm. Isolated DC/DC converter with innovative switching low loss switching topologies, advanced control loop design, low internal and output inductance, high slew rate output, and advanced component technologies are of interest. DC/DC converters incorporating advanced low loss switches, low inductance high common-mode isolation transformer, low loss inductors, advanced thermally enhanced board, and advanced control loop design are of interest.

PHASE I: Identify potential new and innovative research and development approaches to meet the power conversion needs discussed in this topic. Develop and design a conceptual fast responding isolated DC/DC converter for pulsed current loads and perform supporting analysis and critical technology demonstrations, if required.

PHASE II: Develop a prototype DC/DC converter for pulsed current loads based upon the Phase I design effort. Demonstrate the capability of the converter under pulsed load conditions and also demonstrate commercial viability of the proposed converter.

PHASE III: Develop pre-production and production components and sub-systems for integration into radar systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL: These technologies could be applied in many power applications such as the telecommunications industry, commercial airport radar systems, and automotive industry.

REFERENCES:
1. Mohan, Undeland, and Robbins, Power Electronics: Converters, Applications, and Design, New York, John Wiley & Sons, 1995.

2. M. Brown, Power Supply Cookbook, Butterworth-Heinemann, Newton, MA, 1994.

3. R. W. Erickson, Fundamentals of Power Electronics, New York, Chapman and Hall, 1997.

4. D. M. Mitchell, DC-DC Switching Regulator Analysis, New York, McGraw-Hill, 1988.

5. A. Kislovski, R. Redl, and N. Sokal, Dynamic Analysis of Switching-Mode DC/DC Converters, New York, Van Nostrand Reinhold, 1994.

6. McGee, B.R.; Nelms, R.M. "Powering solid state radar T/R module arrays from a fuel cell using an isolated Cuk converter, " Applied Power Electronics Conference and Exposition, 2004. APEC '04. Nineteenth Annual IEEE, Volume 3, 2004 Page(s):1853 – 1857, 2004.

KEYWORDS: radar, phased array, power, power conversion, energy storage, DC-DC converter, fast transient response, pulse current load

N08-170 TITLE: Innovative Power Amplifier Gate Thermal Management for Active Radar Systems

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: High power radar modules are required for Electronically Scanned Arrays (ESA) to provide significant system performance improvements. These modules from a system perspective are a major portion of the system cost and they provide thermal and reliability challenges to designers and manufacturers that must be over come to provide effective ESA solutions. Innovative passive technologies that help mitigate thermal management issues resulting from component device junction thermal dissipation are sought. Improved designs for optimized electrical and thermal performance as well as thermal management mateirals and processes that can support high power densities of wide bandgap power amplifiers are sought.

DESCRIPTION: Current microwave power amplifiers being devleoped will operate at power densities up to 5 times higher than current power amplifer technologies. Low cost design and manufacturing chip-level, component level and module level thermal management technologies are required that reduce operating junction temperatures for these developing high power RF power amplifiers. Wide bandgap semiconductors have demonstrated system performance improvements including size, weight and power. The intrinsic material properties of wide bandgap semiconductors make them ideal engineering solutions for many microwave/millimeter wave radar applications. Wide bandgap power amplifiers have operational power densities several times that of GaAs based devices which enable higher power and longer range target discrimination as well as decreased aperture size. Developing high power wide bandgap devices have power densities that exceed traditional thermal management technologies capabilities significantly. Innovative technologies that target the reduction, efficient spreading or removal of localized heat generated in the gate region of high power wide bandgap devices are sought. Traditional thermal management technologies that address module level heat spreading and module heat removal that improve the device gate power dissipation issue will provide limited benefits, this topic seeks new concepts targeting optimal thermal management solutions that directly address localized gate power dissipation. The selected technologies will address design, material and process technology improvements that significantly improve removal of power dissipated in the region of the wide bandgap semiconductor gate efficiency as well as providing optimal device/module power and efficiency required for effectively addressing ESA system performance.

PHASE I: Identify, model and demonstrate innovative material/design/process technologies that significantly improve device gate level thermal management through reduced power dissipation (higher efficiency) and/or improved heat removal/spreading while maintaining device existing performance. The device junction temperature should be reduced by approximately >30% without degrading component performance, reliability or manufacturability.

PHASE II: Develop and demonstrate a prototype of an identified radar transition module that demonstrates low cost, manufacturability and required thermal performance. The prototype development should validate thermal performance as well as identify reliability and cost of the proposed technologies.

PHASE III: Transition developed technologies into a transition system insertion and demonstrate performance, reliability and cost benefits shall be identified.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The proposed technology shall be of interest to and transitioned to a wide range of ESA applications including radar, EW and communications.

REFERENCES:
1. Francis, D., Wasserbauer, J., Faili, F., Babic, D., Ejeckam, F., Hong, W., Specht, P., Weber, E.R., "GaN-HEMT Epilayers on Diamond Substrates: Recent Progress," Compound Semiconductor Manufacturing Technology Conference, May 13-18, 2007, Austin.

2. http://www.sp3inc.com/pdf/dia_pins.pdf.

3. http://amsacta.cib.unibo.it/archive/00001374/01/GA052242.PDF.

KEYWORDS: ESA;Radar; EW; Thermal Management; Device Junction;power amplifier.

N08-171 TITLE: <u>Reliable Acoustic Path Vertical Line Array</u>

TECHNOLOGY AREAS: Sensors, Battlespace

ACQUISITION PROGRAM: IWS5 Undersea Systems; non ACAT

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop component level and system level technologies for reliable acoustic path vertical line arrays.

DESCRIPTION: In recent years the U.S. Navy has researched the utility of deep water (i.e., 6 km depth, 3 deg C temperature) acoustic sensing technologies that exploit the reliable acoustic path (RAP) [1] using vertical line arrays (VLAs) of vector sensors [2,3]. The first RAP VLA array was large and deployed over the side of a research vessel [3]. The sensing nodes consisted of a pressure hydrophone, a triaxial pressure-gradient hydrophone, and an electronics housing all contained within a free-flooding plastic frame having a diameter and length of 13-in x 41-in. The measured acoustic signals were routed to a central node that served as a data recorder. Future arrays will be smaller and deployed from tactical naval platforms using existing packaging modalities (i.e., sonobuoy, torpedo, etc.). A target form factor for future array sensing elements and associated electronics is desired to be less than an AN/SSQ-53 DIFAR wet-end transducer [i.e., a cylinder having nominal dimensions of 5-in (D) x 5-in (L)]. The reduction in form factor is substantial and will require novel sensor and preamplifier designs to ensure that the electronic noise floor of the system is well below the ambient noise level at depth [3]. Moreover, it is envisioned that future arrays will operate autonomously with persistence to support ambient noise and anti-submarine warfare studies over the frequency range from a few hertz to several kilohertz. Data will be recorded and processed in situ then relayed to platforms of opportunity via suitable means (i.e., acoustic modems or equivalent technologies). This feature is new relative to the existing system which only employed a data recorder [3]. It is the intention of this SBIR topic to solicit technical concepts to support development of RAP VLAs at the component and system level. Component level technologies include miniature low noise vector sensors, array electronics and telemetry, DC power generation and distribution, and transducers to support communication between the array and the host platform. System level technologies include end-to-end array design, conventional and advanced signal processing techniques suitable for a deep water vector sensor line array, packaging and deployment concepts, and communication modalities.

PHASE I: Perform analytical modeling studies of the component or system to ensure that it is suitable for RAP VLA operation. If possible, perform proof-of-concept experiments to supplement the modeling studies.

PHASE II: Refine the models during Phase I, then fabricate and test prototype components and systems.

PHASE III: Integrate components and systems into a full-up array which will be deployed at-sea for a full-scale demonstration test.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed herein is applicable to researchers engaged in ocean ambient noise surveys, deep water acoustic propagation studies, bio-acoustic monitoring of marine life, and seismic surveys in support of geophysical prospecting.

REFERENCES:
1. "Underwater Acoustic Modeling and Simulation" by Paul Etter; 3rd Edition; Taylor and Francis 2003.

2. J. Nickles, G. Edmonds, R. Harriss, F. Fisher, W. S. Hodgkiss, J. Giles and G. D'Spain, "A Vertical Array of Directional Acoustic Sensors," Proceedings of Mastering the Oceans Through Technology (Oceans 92), Oct. 1992.

3. J. McEachern, J. McConnell, J. Jamieson, and D. Trivett, "ARAP - Deep Ocean Vector Sensor Research Array," Conference Proceedings, IEEE / Oceans 2006, Sept. 2006.

KEYWORDS: Reliable acoustic path; vertical line array; vector sensor; array processing; ocean ambient noise; deep water acoustic propagation

N08-172 TITLE: <u>High-Efficiency Solid-State S&X-Band Radar Power Amplifiers</u>

TECHNOLOGY AREAS: Sensors, Electronics

ACQUISITION PROGRAM: PEO IWS 2.0 Air and Missile Defense Radar, ACAT I

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop innovative models, circuits, and MMIC high power amplifiers with power added efficiency 10-20 percent greater than current class AB amplifiers.

DESCRIPTION: Inefficiencies in RADAR transmitters lead to large prime power and cooling requirements for RADARs. The resulting RADAR prime power and cooling needs have a significant impact on RADAR weight, deckhouse volume, and cost and in turn can drive platform design. These problems are exacerbated for Ballistic Missile Defense (BMD) applications requiring long pulse lengths. Power amplifier (PA) inefficiencies are the driving factor for transmitter inefficiencies and improvements in power amplifier efficiency will provide significant RADAR and platform benefits.

PHASE I: Identify and analyze potential innovative research and development approaches to address the PA performance issues discussed in this topic.

PHASE II: Demonstrate S-band PA MMIC with = lot average 60% PAE. Integrate PAs into packaging representative of that used in a phased array application and evaluate with RADAR waveforms. The PA shall be compatible with S-band phased array RADAR requirements and packaging. The ability to perform classified research may be required.

PHASE III: Transition this technology into an operational radar transmit/receive module.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The high-efficiency transmit modules should have application to all avionics manufacturers, communications, commercial radar applications, and all marine radar applications.

REFERENCES:
1. R. Tayrani, “A Highly Efficient Broadband (7-14 GHz) Monolithic Class E Power Amplifier for Space Based Radar,” IEEE RFIC Symposium, June 2007, pp. 721-724.

2. Y. Woo, Y. Yang, “Analysis and Experiments for High-Efficiency Class-F and Inverse Class-F Power Amplifiers,” IEEE Transactions on Microwave Theory and Techniques, Vol. 54, No. 5, May 2006, pp. 1969-1974.

KEYWORDS: Power Added Efficiency; Power Amplifier; non-linear modeling.

N08-173 TITLE: Intelligent Network Traffic Management

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PEO PMS IWS5E Undersea Warfare - Decision Support Systems, ACAT II

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop automated/intelligent network traffic management algorithms and implementations to support OA/SOA network communications over constrained communications channels.

DESCRIPTION: Many current undersea warfare (USW) combat systems are employing open architecture (OA) implementations that rely on many middleware and communications protocols. The approach that many of these systems take when faced with constrained network communications channels is to utilize highly coupled brokers to read and repack all data for transmission. This approach requires costly reengineering and/or refactoring of the bandwidth as new features are included with future upgrades. Additionally, future systems are implementing Service Oriented Architectures (SOA) for rapid and distributed data access and control. The emergence of SOA, web-service interfaces, along with universal, description, discovery, and integration (UDDI) registry services facilitate the integration of virtual every (USW) combat subsystem and cross platform components. These architectures rely on significant network traffic principally over protocols like SOAP, HTTP/HTTPS, and Axis Multi-Part and Streams. The future USW environment will include distributed networks of multiple sensor and target engagement modules deployed on airborne, surface, and sub-surface platforms that may be manned or unmanned. These loosely-coupled data-intensive SOA architectures will produce new bandwidth demands upon existing shipboard and cross platform network infrastructures.

A major challenge that SOA integration introduces is the effective management of data throughput. Current commercially available XML security gateway products protect web service transactions from malicious code attacks, support data encryption, and enable authentication services. Current network load-balancing products that make application-level decisions based on packet inspection do not support making dynamic packet-level decisions about XML content. Strides have been made in the financial sector to integrate content-based routing tags into XML schema to be interpreted by XML gateway routers in and effort to increase overall quality of service (QoS).

To reduce to costs of system implementations where limited bandwidth access to networks is an issue (i.e. ship to ship communications) approaches to control SOA packet traffic based on the tactical and network operating conditions is imperative. This topic seeks development of open architecture approaches, algorithms, and implementations of network traffic conditioning and filtering which are programmable and dynamically adapt to current operational context/conditions. Approaches should address content and priority based management (routing and filtering) schemes and dynamic context based filtering (e.g. threat condition impact on network loading and use). All approaches must address the types of data/information communicated (tracks, plans, command, control, conversation, etc), priority and management policies, and implementation/application impact on SOA services.

PHASE I: Research and design open architecture approaches, algorithm, and tools for network traffic management across band-limited communications channels. Emphasis will be placed on implementation practicality, open architecture support, and impact on existing or future applications/SOA services.

PHASE II: Implement the Phase I approach and algorithms in a prototype software system. Evaluate performance of implemented approaches/algorithms under simulated mission/stress conditions.

PHASE III: Integrate the Phase II implementation into a US Navy system. Demonstrate and document performance measured during at-sea trials.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology has direct application to commercial sector OA network traffic management in time sensitive or band limited networks. This technology has direct application to commercial banking, financial, and accounting systems. Advances in XML content-based routing technology could be used to right size computer internet bandwidth infrastructure that would lead to billions in potential savings.

REFERENCES:

1. IETF RFC 2475 “An Architecture for Differentiated Services”, Blake, et. al., December 1998.

2. Ferguson P., Huston G., Quality of Service: Delivering QoS on the Internet and in Corporate Networks, John Wiley & Sons, Inc., 1998. ISBN 0-471-24358-2.

3. Service-Oriented Architecture: A Field Guide to Integrated XML and Web Services, Thomas Erl, Prentice Hall, April 2004.

4. Hitchhikers Guide to Network and Wan Optimization Technologies, APConnections, Inc. http://www.netequalizer.com/bandwidthwhitepaper.php

KEYWORDS: Intelligent agents, Automation, Networks traffic conditioning, Network traffic filtering.

N08-174 TITLE: Interoperability and compatibility techniques for Counter Radio controlled IED Electronic Warfare (CREW) and other Radio Frequency Communication

TECHNOLOGY AREAS: Ground/Sea Vehicles, Battlespace

ACQUISITION PROGRAM: PMS 408 Counter Radio Controlled IED Electronic Warfare

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop novel solutions to make CREW and other RF spectrum users such as Blue Force Communications seamlessly compatible and interoperable.

DESCRIPTION: DOD's demand for spectrum use and associated interference deconfliction has increased. CREW and other radio frequency systems such as Blue Force RF related equipment may operate in close proximity to one another. Transmissions from CREW may cause inadvertent impact to Blue Force RF related equipment, and Blue Force RF related equipment may cause inadvertent impact to CREW. Multiple CREW systems operating in close proximity to one another may have inadvertent impact on each other. Techniques are needed to mitigate the risk of inadvertent interference and to optimize CREW and Blue Force RF related equipment systems interoperability and compatibility for end users.

PHASE I: Investigate and analyze candidate techniques and technologies that will maximize interoperability and compatibility and minimize mutual interference between surrogate CREW and other blue force RF related equipment systems. Develop conceptual designs and specifications that can reduce or eliminate interference from single and multiple sources, including statistical analyses to enable identification of most promising approaches. The conceptual designs should include cost benefit analysis and identify the risks and risk mitigation strategies associated with the proposed solutions.

PHASE II: Apply one or more of the most promising concept(s), develop prototype software and/or hardware that can be integrated with a surrogate CREW hardware platform and tested with CREW surrogate and communications radio systems. Testing includes laboratory/bench testing using closed loop methods, as well as limited field demonstration of the prototype hardware, software and/or firmware in over-the-air tests.

PHASE III: Based upon test results and lessons learned, refine the most successful concept(s) into a more final form and integrate the refined capability into actual CREW hardware. Conduct field tests to establish baseline capability of the implementation.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology may be applicable to commercial RF systems that experience interference when operating in close proximity to one another.

REFERENCES:

1. MIL-STD-461E Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.

2. DODI 6055.11 protection of DoD Personnel from Exposure to Radio Frequency Radiation and Military Exempt lasers.

3. IEEE C95.1-91 Safety Levels with respect to Human Exposure to radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz.

4. JCREW S&T Program Category D01 Blue Force COMMS Data and Video Compatibility.

KEYWORDS: RF interference, RFI, electromagnetic interference, EMI, system compatibility, radio interference.

N08-175		TITLE: Wideband Conformal Antenna

TECHNOLOGY AREAS: Ground/Sea Vehicles, Battlespace

ACQUISITION PROGRAM: PMS 408 Counter Radio Frequency IED Electronic Warfare (CREW)

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop ultra-wideband (multi-gigahertz) conformal antenna.

DESCRIPTION: Counter Radio Frequency IED Electronic Warfare (CREW) systems are being developed to address fixed site, mounted mobile (vehicle/boat), and man portable situations. Many military vehicles and dismounted patrols will utilize Joint Counter Radio Frequency IED Electronic Warfare (JCREW) hardware in the future. Antenna placement and platform interface can cause a multitude of significant unintended problems. Issues include antenna pattern blockage, co site interference, incompatibility with other platform mounted systems, breakage, non standard interface, visual signature, etc. Conformal antennas that can be seamlessly integrated to the host platform may significantly reduce the visual signature, system integration problems, and performance challenges associated with platform interface.

PHASE I: Develop a conceptual design for a wideband conformal antenna or antenna array that can be utilized primarily for vehicular based applications.   Mine Resistent Ambush Protected (MRAP) Vehicle may be used as the primary objective vehicle platform.

PHASE II: Fabricate a prototype wideband conformal antenna for testing on CREW equipped vehicles.

PHASE III: Fabricate a pre-production conformal antenna for integration into next generation CREW hardware.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology may be applicable to commercial applications involving RF communications. Conformal antennas will have other applications other than vehicular based.

REFERENCES:

1. MIL-STD-461E Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.

2. DODI 6055.11 protection of DoD Personnel from Exposure to Radio Frequency Radiation and Military Exempt lasers.

3. IEEE C95.1-91 Safety Levels with respect to Human Exposure to radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz.

4. JCREW S&T Program Category A02 Antenna vehicle applications, A03 Antennas dismounted applications.

KEYWORDS: Conformal antenna; RF communications; wideband operation; low profile; lightweight; antenna array.

N08-176 TITLE: Non-Lethal Swimmer Deterrent

TECHNOLOGY AREAS: Electronics, Battlespace, Weapons

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a non-lethal swimmer deterrent using an underwater electrical field of approximately 2 volts/ft to produce paralysis of muscles.

DESCRIPTION: The Maritime Expeditionary Security Force (MESF), as a component of the Navy Expeditionary Combat Command (NECC), will fill current warfighting gaps by providing highly trained scaleable and sustainable security teams capable of defending mission critical assets in the near-coast environment. The US Navy Acquisition Program Office for Anti-Terrorism Afloat (PMS 480) in support of MESF, has identified a non-lethal swimmer deterrent system is required for the Navy Expeditionary Security System (NESS) Combat System Program to protect docked and anchored vessels from swimmer terrorist attacks. The goal of this topic is to develop a portable system that will provide a cone of protection using an underwater electrical field to deter a surface and submerged swimmer. The innovative challenge is to be able to control the underwater electrical field in order to prevent the system from becoming lethal. The system shall be of a cascade design to allow for adaptability of use (e.g. provide a cone of protection around an anchored vessel or protection of a harbor entrance). The system shall be deployable and retrievable by a maximum of two persons from a 24 to 28 foot surface craft. The system shall be compatible with standard shore power and ship service power. The system shall be designed to be deployed for a minimum of three weeks and will be activated upon validation of a known threat. The system must be able to cover the range of depth from the surface to 150Ft and while producing an electric field strength of approximately 2 volts/ft. The system must provide a cone of protection up to 200 yards from the vessel but have zero effect within 150 feet of the vessel or pier. The system shall not interfere with shipboard or pier side electronic systems or cathodic protection systems. System design shall consider all environmental effects such as sea life etc. The system will be deployed at remote locations in the field and will be required to be unclassified. It is unforeseeable that the product as a result of Phase II will be classified or require access to classified material.

PHASE I: Develop a specific non-lethal swimmer deterrent system design including hardware and software. Identify the high risk technical challenges and provide breadboard evidence of the ability to meet them.

PHASE II: Fabricate a prototype system and perform non human tests that will replicate actual effects on a swimmer. Finalize the concept design and make recommendations for Phase III production-oriented designs.

PHASE III: Produce and conduct testing of close-to-production model system. Transition the technology to PMS 480 Expeditionary programs.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: During time of GWOT, terrorist swimmer deterrents become a vital role in protecting harbors and off-shore structures. Much of the technology developed under this effort will be applicable to homeland defense, law enforcement, and private sector security.

REFERENCES:
1. Underwater Electrical Safety for Divers, Underwater Magazine, July/August 2004.

2. AODC (IMCA), Code of Practice for the Safe use of Electricity Under Water, Association of Offshore Diving Contractors, 1985.

3. Dalziel, C. F., “Electric Shock Hazard”, IEEE Spectrum, Vol. 9, No.2, 1972.

4. Hackman, D. J. and J. S. Glasgow, “Underwater Electric Shock Hazards”, Journal of Ocean Technology, Vol. 2. No. 3, 1968.

5. Bove, A. A., “Underwater Electrical Hazards and the Physiology of Electric Shock.”

KEYWORDS: Diving; Underwater; Combat Swimmer; Electricity; Terrorism; Harbor Protection.

N08-177 TITLE: Offboard Refueling Support System for Unmanned Surface Vehicles

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 501, Littoral Combat Ship Program, ACAT I

OBJECTIVE: Develop the capability for an Unmanned Surface Vehicle (USV) to perform function of a refueling tanker for refueling other offboard systems (USVs or unmanned underwater vehicles) without restricting host ship operations.

DESCRIPTION: Modern combatants are being designed to rely on offboard organic watercraft such as boat-based unmanned surface vehicles for primary mission focal areas. Because these watercraft have limited operational times due primarily to fuel consumption, it is a requirement that they periodically return to the host ship to be refueled. The time required to transit to the ship, be recovered by the ship, be refueled, be launched by the ship, and return to the operational area can be lengthy, and takes these watercraft out of an operational condition. Having a capability to launch an USV that carries fuel to the operational watercraft allows the watercraft to stay on station longer. The desire would be for the refueling USV to have the ability to transit to the watercraft, connect a refueling hose to a common port on the watercraft, refuel the watercraft, detach the refueling hose, and return to the host ship without human intervention. The challenge will be to develop an automated refueling hose capability that can detect the fueling port on a variety of watercraft with different orientations which are potentially moving due to sea state conditions. The ability to properly connect, disconnect and seal the fueling port during transfer operations without spilling fuel into the water or creating a fire hazard onboard either vehicle is critical to success. Concepts proposed should be able to operate in moderate sea states (up to 6 foot waves), should not exceed a length of 40 feet and should comply with existing launch, recovery and storage protocol for the host ship.

PHASE I: Develop and demonstrate the feasibility of an offboard refueling support system for unmanned surface vehicles that will provide the above capabilities. Approaches should address the concept of operations and projected capabilities, system descriptions, concept drawings, and applicable interface requirements.

PHASE II: Finalize the design, fabricate and demonstrate a prototype of the system developed in Phase I. Through land-based testing, demonstrate the functionality of the prototype. Develop detailed concept of operation and projected capabilities, prototype descriptions, production drawings, interface specifications, operating sequences, emergency procedures, logistics support plan, weight breakdown, system cost estimates (both acquisition and lifecycle), and manning/Human Systems Interface (H.S.I.) requirements.

PHASE III: In Phase III, it is expected that the contractor will work with government and commercial sponsors to finalize the prototype to create a marketable product.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology of automated refueling at sea removes personnel from a potentially hazardous environment, especially when two small watercraft are involved. It provides the marketing potential for unmanned or manned refueling ships to assist stranded watercraft that might otherwise require towing to shore, and improves the technology for contained refueling at sea to prevent fuel spills which are damaging to the environment, and can result in fines and/or prison for offenders, depending upon the size of the spill.

REFERENCES:

1. http://www.fas.org/man/dod-101/sys/ship/unrep.htm.

2. NWP4-014, Replenishment at Sea.

3. ATP 16 Replishment at Sea (Allied).

4. Stowage, Handling and Disposal of Hazardous General Use Consumables, NSTM Ch 670-4.7.2, Rev. 3, 1 May 1997.

5. http://www.navysbir.com/ via the SBIR/STTR Interactive Topic Information System (SITIS) web link or on the World Wide Web.

KEYWORDS: Automated; refueling; unmanned; manpower; offboard; combatants.

N08-178 TITLE: Weld Monitoring Quality

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMS 500, DDG 1000 Program, ACAT 1

OBJECTIVE: Develop and implement innovative technologies that will improve weld quality by actively monitoring the weld process of mechanized and automatic welding machines and identifying the occurrence of poor quality events.

DESCRIPTION: The Navy's Program Executive Office for Ships is leveraging the National Research Program (NSRP) to effect change across the non-nuclear surface shipbuilding, modernization and repair enterprise by coordinating with U. S. shipbuilders to adapt and implement "World Class" commercial best manufacturing practices. This topic seeks innovative scientific and engineering solutions to inefficiencies in long-standing design and engineering methods. This topic offers an opportunity to infuse new ideas/innovations into the smaller, domestic shipbuilding industry. Of particular interest are initiatives with a clear business case.

Proposals should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the estimated benefits will be and how it might be transitioned into the shipbuilding industry. Automated welding processes in the shipyard essentially run “open loop” with only the periodic observation of operational personal of the process due to the volume of welding being done. For a variety of reasons contaminants can be introduced into the welding process which results in poor weld quality including spatter and porosity.

This topic seeks to identify and develop technologies that are capable of being implemented to observe the welding process and to detect the occurrence of weld contamination, e.g., paint, oil, sand. If such occurrences can be detected and welding terminated immediately, then significant reduction in rework costs can be achieved. Such process oversight has not been developed for shipbuilding or for standard welding technologies. Therefore, an innovative, potentially high-risk solution is required. Solutions must be able to be implemented in shipyard welding applications and be compatible with shipyard welding processes.

Of particular interest are initiatives with a clear business case. Proposals should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the specific benefit will be and how it might be transitioned into the shipbuilding industry. NSRP members are available to provide guidance and assistance in the identification of common issues and needs. Contact with these resources is encouraged both prior to proposal development and during any subsequent SBIR-related activity. Teaming with a NSRP member (or Government shipyard) is voluntary and will not be a factor in proposal selection.

PHASE I: Demonstrate feasibility for improvements being developed and also identify impact upon shipbuilding affordability. Include a first order Return-On-Investment (ROI) analysis for industry implementation and estimate potential Total Ownership Cost (TOC) reduction. Establish Phase II performance goals and key developmental milestones.

PHASE II: Finalize the design, as appropriate, and demonstrate a working prototype of the proposed system. Perform laboratory tests to validate the performance characteristics established in Phase I. Develop a detailed plan and method of implementation into a full-scale application.

PHASE III: Implement the Phase III plan developed in Phase II in coordination with the shipbuilding and repair industry.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic shall be directly applicable to current military and commercial shipbuilding operations and repair practices. The products developed should find wide use in most heavy industrial plant/processing facilities such as the power industry and will be marketable to the shipbuilding and repair industry.

REFERENCES:

1. NSRP ASE Strategic Investment Plan, available on line at http://www.nsrp.org

2. US Naval Shipyard information is available at http://www.shipyards.navy.mil

3. Welding and Joining Technologies and Training can be found at http://www.khake.com/page89.html

KEYWORDS: Welding;contaminates;quality control;NSRP;shipbuilding; automation.

N08-179 TITLE: Robust Deployable Superstructure Enclosure System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: PMS 500, DDG 1000 Program, ACAT 1

OBJECTIVE: Development of a rapidly deployable, robust enclosure system for shipboard superstructure surface preparation & coatings operations.

DESCRIPTION: The Navy's Program Executive Office for Ships is leveraging the National Research Program (NSRP) to effect change across the surface shipbuilding, modernization and repair enterprise by coordinating with U. S. shipbuilders to adapt and implement "World Class" commercial best manufacturing practices. The U.S. shipbuilding industry lags behind the global shipbuilding market significantly in adapting new technologies to long-standing inefficient manufacturing processes and improvement is this area is key to closing this gap.

A significant portion of the ship maintenance and surface preparation and coatings (SP&C) work within the shipbuilding industry is performed in open air environments. These environmental conditions reduce the productivity and time in which SP&C operations can be performed. This work is often performed in many different locations throughout the shipyard on large, non flat structures with difficult access. SP&C work is also a source of regulated air emissions which further can complicate the conditions that work must be perform under. Due to these access, environmental and air emissions regulations, productivity of the SP&C worker can be greatly impacted.

Development of an innovative method to enclose SP&C work and effectively removing, or reducing, the environmental and air emissions concerns would greatly increase productivity and decrease overall cost. This new method of enclosing SP&C work should be rapidly deployable, usable and removable to any location in the shipyard under various environmental conditions. The system should be reusable and easily stored with minimum volume when not in use. The system should be minimally susceptible to damage from extreme climate events or ship repair production process occurring within or near the system. It should improve on current environmental containment practices of SP&C work and be able to function on a ship’s superstructures and around complicated geometries. The system should not generate a new solid waste stream. Development of this system would ease scheduling conflicts, reduce emissions regulated under at least NESHAP and NPDES, reduce risk to installation and SP&C workers, reduce cost of enclosure system design, installation, maintenance, disassembly and disposal of containment materials.

Of particular interest are initiatives with a clear business case. Proposal should specifically describe the technology that will be applied to solve the problem, how it will be developed, what the specific benefit will be and how it might be transitioned into the shipbuilding industry. NSRP members are available to provide guidance and assistance in the identification of common issues and needs. Contact with these resources is encouraged both prior to proposal development and during any subsequent SBIR-related activity. Teaming with a NSRP member (or Government shipyard) is recommended but will not be a factor in proposal selection.

PHASE I: Demonstrate feasibility for improvements being developed and also identify impact upon shipbuilding affordability. Include a first order Return-On-Investment (ROI) analysis for industry implementation and estimate potential Total Ownership Cost (TOC) reduction. Establish Phase II performance goals and key developmental milestones.

PHASE II: Finalize the design, as appropriate, and demonstrate a working prototype of the proposed system. Perform laboratory tests to validate the performance characteristics established in Phase I. Develop a detailed plan and method of implementation into a full-scale application.

PHASE III: Implement the Phase III plan developed in Phase II in coordination with the shipbuilding and repair industry.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The technology developed under this topic shall be directly applicable to current military and commercial shipbuilding operation and repair practices. The products developed should find wide use in most heavy industrial plant/processing facilities such as the power industry and will be marketable to the shipbuilding and repair industry.

REFERENCES:

1. NSRP ASE Strategic Investment Plan, available on line at http://www.nsrp.org

2. US Naval Shipyard information is available at http://www.shipyards.navy.mil

KEYWORDS: Superstructure; enclosure; vessel repair technology; pollution control; NSRP; ship repair.

N08-180 TITLE: Adhesives for Rapid Outfitting and Insulation Attachment

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PMS 500, DDG 1000 Program, ACAT 1D

OBJECTIVE: Develop and implement a high temperature insulation attachment system utilizing adhesives for use in rapid outfitting and new construction installation.

DESCRIPTION: Currently, the primary method of attaching insulation during outfitting and new construction is through the used of welded studs. Traditionally, these studs are attached to decks and bulkheads early in the construction process evolution and as a result are often damaged before the construction process is complete. Any changes or additions late in the construction process require additional “hot-work” which can be expensive to arrange and may damage existing finishes.

This topic seeks innovative, cost-effective scientific and engineering solutions to replace the traditional welded stud method of insulation attachment on both steel and composite bulkheads. Of particular interest are proposals utilizing high temperature (in excess of 300oF) adhesives in conjunction with a “pin” type of attachment device. The concepts proposed should be able to be implemented by no more than a couple of individuals and should have physical and mechanical properties conducive to operation under extreme conditions up until compartment tenability limits. Concepts will be required to meet applicable fire, smoke, toxicity and shock requirements.

The development of an insulation system attachment alternative will reduce the cost and time for insulation attachment and reduce associated monitoring and inspection steps. Portability and use in confined shipboard spaces are critical attributes of any solution, as well as compatibility with current and pending environmental, safety and health regulations. Candidate technologies that require limited resources (electrical, water, high-pressure air, etc.) are most desirable.

PHASE I: Demonstrate feasibility for improvements being developed and also identify impact upon shipbuilding affordability. Include a first order Return-On-Investment (ROI) analysis for industry implementation and estimate potential Total Ownership Cost (TOC) reduction. Establish performance metrics to analyze the feasibility of the proposed solution. Develop a test and evaluation plan that contains discrete milestone for product development for verifying performance and suitability.

PHASE II: Develop and demonstrate prototype materials/methods based on Phase I results. In a laboratory environment, demonstrate that the prototype(s) meet the performance goals established in Phase I. Demonstrate installation and applicable maintenance methodologies. Provide detailed production/installation plans and estimates, production drawings, logistic support plans, weight breakdown, and system cost estimates (both acquisition and lifecycle).

PHASE III: Working with the Navy, develop transition plans and demonstrate the commercial and shipboard uses. Coordinate with the Navy to develop and execute plans for shipboard installation in a suitable application in conjunction with a Navy ship acquisition program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Insulation systems are widely used in commercial marine shipbuilding, offshore platforms, and aircraft industries where fire safety is of high interest. Development of an alternative improved method of insulation attachment will reduce the cost and time associated with installation and maintenance.

REFERENCES:

1. http://assist.daps.dla.mil/quicksearch/

2. "Performance Specification Insulation, High Temperature Fire Protection, Thermal and Acoustic," MIL-PRF-32161.

3. "Adhesives, Fire-Resistant, Thermal Insulation " MIL-A-3316C(2).

4. "Shock Tests. H.I. (High-Impact) Shipboard Machinery, Equipment, And Systems, Requirements For", MIL-S-901D.

KEYWORDS: Adhesive; High temperature; stud; insulation; fastener; bulkheads.

N08-181 TITLE: High Efficiency and High Power Quality Electrical Power Conversion

TECHNOLOGY AREAS: Ground/Sea Vehicles

ACQUISITION PROGRAM: PMS 502, CGX Program, ACAT I pre AoA

OBJECTIVE: To develop a set of flexible and adaptive power modules that can be easily tailored to future surface combatant shipboard medium voltage systems and provide the power quality necessary for high power weapons systems in an efficient, power dense, low cost, and modular manner.

DESCRIPTION: Future Navy combatants will have a variety of system loads with varying voltage/current and power quality requirements. This topic addresses the development of power conversion units (incorporating advanced power switching devices and passive components) for use in a high quality of service application. The goal is to provide improved electrical power quality in a highly reliable manner where critical electric loads do not experience loss of source power during higher level power system fault conditions. As next-generation integrated power system architectures evolve, the shipboard high voltage bus that this power conversion unit connects to may be set at a variety of voltage levels, including 4160-13,800VAC at frequencies between 60 and 400Hz or up to 6kVDC. The power conversion unit developed by this topic will have to be adaptable to match the chosen voltage levels, with minimal changes necessary for each voltage level identified above. Present power electronics technology is able to satisfy most shipboard electrical performance requirements, but does so at a reduced power quality than high power combat systems require, necessitating the need for multiple levels of power conversion and conditioning. Concept proposed should be able to produce high-power quality at voltages adjustable between 800 to 1000VDC and should be scalable up to 6MW. Concepts should also address the ability to easily adapt to the various input voltages, the ability to convert power efficiently, the ability to provide quality power, the ability to provide reliable power, and input to output galvanic isolation.

Performance goals will be as follows, but improvements over these goals are desirable:
- Parameter
- Goal
- Threshold
- Condition
- Steady State Voltage regulation:
- <+/-0.1% of set point
- +/-3.5% of set point
- Transient Voltage regulation:
- +/-1% of set point

- Step load change of 0-100%, 100-0% at 100MW/sec
- Transient Voltage regulation +8.5%/-16.5% of set point
- Step load changes of 0-50%, 33-100% and 100-0% at 70Mw/sec
- Conversion Efficiency: 80%, 75%, 20% rated load
- Conversion Efficiency: 97%, 96%, 35% rated load
- Conversion Efficiency: 98%, 96.5%, 40 to 100% rated load
- Steady state ripple voltage: 0.2% peak to peak 2.0%
- Mean Time Between Failures: 35,000 hours
- Mean Time To Repair: 2 hours

PHASE I: Demonstrate the feasibility of the development of a set of flexible and adaptive power modules to meet the defined performance objectives. The concept design should be in sufficient detail to estimate the size, weight, and cost of the converter. Assess the impact of meeting goals in terms of size, weight and cost and identify if there are any break-points between minimum requirements and goal requirements relative to size, weight, and cost. Specific requirements for size, weight and cost are not available at this time but size, weight and cost are important and will be factors in selecting concepts for further development. Assess the impact of the variety of input voltage levels and the level of modularity attainable on the concept design. Modeling and simulation as well as three-dimensional computer aided design are encouraged to demonstrate the performance and feasibility of proposed approaches. Develop a test and evaluation plan that contains discrete milestones for product development for verifying performance and suitability.

PHASE II: Develop and demonstrate the prototype(s) as identified in Phase I. Through system simulations, demonstrate and validate the performance goals as established in Phase I. Refine and demonstrate the capabilities of the system. Develop a cost benefit analysis and a Phase III testing and validation plan.

PHASE III: The small business will work with the Navy and commercial industry to transition a final system that is modular to accommodate various shipboard power system architectures. The small business will participate in an integrated product team environment to develop the detailed interfaces require to integrate the converter with the power system and the combat systems loads.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: These approaches could be used in any system where high power density power converters are used – electric vehicles, aircraft power system, distributed generation (wind energy) among others.

REFERENCES:
1. Shipboard electric power quality of service; Doerry, N. H.; Clayton, D.; 2005 IEEE Electric Ship Technologies Symposium, pp. 274-279.

2. Shipboard Implementation of US Navy's Integrated Fight Through Power and Planned Open Control System Architecture; Hegner, H.; Spivey, N; Cherry, J; Desai, B; 2005 Proceedings of the All Electric Ship Conference, Paris, France.

3. Power electronics innovation with next generation advanced power devices; Ohashi, H.; Telecommunications Energy Conference, 2003. INTELEC '03. The 25th International 19-23 Oct. 2003 Page(s):9 - 13.

4. Power Electronics Building Blocks and potential power modulator applications; Ericsen, T.; Tucker, A.; Power Modulator Symposium, 1998. Conference Record of the 1998 Twenty-Third International 22-25 June 1998 Page(s):12 - 15.

5. Design and technology of compact high-power converters; Shenai, K.; Neudeck, P.G.; Schwarze, G.; Energy Conversion Engineering Conference and Exhibit, 2000. (IECEC) 35th Intersociety Volume 1, 24-28 July 2000 Page(s):30 - 36 vol.1.

6. Three-Dimensional Packaging for Power Semiconductor Devices and Modules; Calata, J.N.; Bai, J.G.; Xingsheng Liu; Sihua Wen; Guo-Quan Lu; IEEE Transactions on Advanced Packaging; Aug. 2005 Page(s): 404 – 412.

7. Assessment of medium voltage PWM VSI topologies for multi-megawatt variable speed drive applications; Shakweh, Y.; Lewis, E.A.; Power Electronics Specialists Conference, 1999. Volume 2, 27 June-1 July 1999 Page(s):965 - 971 vol.2.

KEYWORDS: Quality of service; power electronics; power distribution; semiconductor devices; propulsion system components.

N08-182 TITLE: Autonomous Hull Inspection

TECHNOLOGY AREAS: Ground/Sea Vehicles, Materials/Processes

ACQUISITION PROGRAM: PMS 501, Littoral Combat Ship Program, ACAT 1

OBJECTIVE: To develop a shipboard capability for autonomous hull inspection both above and below the waterline while in port or at sea.

DESCRIPTION: Currently, underwater hull inspections are performed manually by divers in the water or through the use of a submersible remote operating vehicle. Above the waterline inspections are performed manually by ship's personnel. These inspection evolutions are generally performed in port or at applicable support facilities which requires advanced planning and the use of highly skilled and trained personnel.

This topic seeks innovate approaches toward developing an autonomous system that will provide the capability of inspecting the entire hull of a ship while in port or at sea. The system shall provide for classes of inspection criteria to include, but not be limited to, marine sea life, hull geometry, hull physical characteristics (e.g., smoothness, penetrations, and thickness) together with operator defined thresholds for determining a difference from a prior inspection. The system shall retain prior inspection results and determine any changes from the prior inspections to include, but not be limited to, build-up of sea life (e.g., barnacles), mine or mine-like objects, hull penetrations, discontinuities in the hull (e.g., crack formation or internal corrosion), and physical differences from previous inspections. The system shall also determine and retain areas of interest based on the differences found by analysis of the inspection data. The system will alert an operator of any differences found and will retain the difference information for future inspections. The system shall allow an operator to classify the differences into classes of severity for future inspections and analysis including the setting of thresholds for defining a new difference. The system shall be capable of functioning in a manual mode and should be developed in such a way as to minimize ship impact (e.g., size, weight, power, stowage, etc.) as well as the operational and personnel efforts to initiate, execute, and terminate the inspection process.

PHASE I: Develop and demonstrate the feasibility of an autonomous hull inspection system that will provide the above capabilities. Approaches should address the concept of operations and projected capabilities, system descriptions, concept drawings, and applicable interface requirements.

PHASE II: Finalize the design, fabricate and demonstrate a prototype of the system developed in Phase I. Through land-based testing, demonstrate the functionality of the prototype. Develop detailed concept of operation and projected capabilities, prototype descriptions, production drawings, interface specifications, operating sequences, emergency procedures, logistics support plan, weight breakdown, system cost estimates (both acquisition and lifecycle), and manning/Human Systems Interface (H.S.I.) requirements.

PHASE III: In Phase III, it is expected that the small business will work with government and or commercial industry to finalize the prototype for use on Naval or commercial platforms.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The Hull Inspection System would be applicable to many fields. Its applications could include inspections of pilings/seawalls, hull inspections on commercial ships, surveillance and reconnaissance, or other underwater inspection activities.

REFERENCES:

~~1. NAVSEA S9086-DA-STM-000 NSTM CHAPTE 100(Hull Structures).~~

2. NAVSEA T9074-AS-GIB-010/271- Requirements for Non-destructive testing Methods.

3. US Navy Diving Manual Volume 1.

4. The Underwater Work techniques Manual Volume 2.

5. NAVSHIPS Technical Manual, Waterborne Underwater Hull Cleaning of Surface Ships Chapter 081.

6. http://www.navysbir.com/ via the SBIR/STTR Interactive Topic Information System (SITIS) web link or on the World Wide Web.

KEYWORDS: Hull; Inspection; Underwater; Unmanned; Autonomous; UV.

N08-183 TITLE: Next Generation Combat System Development Approach

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: ACAT 1D

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Establish a new “System of Systems” development approach that utilizes and unifies new technologies and approach to modeling, simulation, measures of effectiveness, data meanings and ontologies, the semantic web, Function Extraction, and Service Oriented Architectures for combat system development.

DESCRIPTION: Present software technologies supporting the design and operation of computing systems and applications treat individual layers and components in an isolated fashion. Protocols and Application Programmer Interfaces (APIs) are layered and are unified, for example, but are not tied to system data models, performance, data specifications and meaning, or data mining requirements. This isolated approach had been reasonably successful when the computing systems and the applications were relatively simple. However such approaches are inadequate in supporting the emerging complex applications and computing platforms, in which large complex systems of systems are to be designed, created, and maintained, and will interoperate with distributed, ad-hoc and unreliable Enterprise-level networks.

Bringing new technologies to the forefront of a “System of Systems” approach to combat system development would greatly increase the openness and affordability of rapid the technology transitions needed to maintain superiority. A key factor in making this transition is the task of understanding program behavior. However, today it is an error-prone, resource-intensive process carried out in human time scale, primarily through program reading and analysis. Yet fast and precise understanding of software behavior is essential, not only for discovering errors and vulnerabilities, but also for improving software specification, architecture, design, implementation, and maintenance artifacts and the development processes that produce them. Large and complex software systems are hard to understand because they contain an immense number of execution paths, any of which may contain errors or security exposures. New and future computing platforms and applications are far more advanced, powerful, dynamic and complex than in the past. Such platforms include both the globally-distributed, meta-computing, heterogeneous, networked, and adaptive platforms, ranging from assemblies of networked workstations, to networked supercomputing clusters or combinations thereof (Grids), as well as the more tightly coupled future petaflops platforms, which will be enabled as grids-in-a-box (GiBs).

Faced with massively complex systems of systems, developers often achieve no more than a general understanding of specified and unspecified (malicious or simply unintended) behaviors. This technology gap in program understanding lies at the heart of many persistent problems in software and systems engineering, and it is a major cost and schedule driver. Such complexity requires new systems' software technology for the design, development, run-time support, maintenance and management of the applications and their platforms. The new software technologies need to adopt a more integrated view of the architectural layers and software components of a computing system, consisting of: the applications, the application support environments (languages, compilers, application libraries, linker, run-time support, security, visualization, etc.), operating system (scheduling, resource allocation and management, etc), computing platform architectures, processing nodes and network layers.

PHASE I: Identify feasible approaches to adopt new technologies for combat system environments that can be used to create reference architectures and adapt to different mission areas and tactical applications. Identify standards used for data ontologies, modeling, simulation, and learning for applicability in a tool that guides the development of a mission-based architecture from the reference architecture. Provide approaches for data mining and data analysis technologies that can feed back into the process to update the reference model from the measurements of effectiveness of the system. Identify tools that begin with developing system models, data ontologies, and higher-level programming languages that can be integrated into a top-down approach for system design and maintenance of the total system architecture. Identify technologies that will provide data mediation to the larger distributed networks, supporting unreliable data exchange and ad-hoc network composition.

PHASE II: Develop a reference architecture and the tools required to derive a context-based mission architecture from the reference model. Develop a prototype architecture that incorporates selected new technologies for the replacement and improvement of legacy systems or sub-systems, based on the reference architecture and the modeling tools. Provide the assessment of the total system impact. Engage the applicable open systems standard consortiums (Object Management Group (OMG) and Organization for the Advancement of Structured Information Systems (OASIS)) as applicable to promote or migrate standards.

PHASE III: Develop a fieldable system or subsystem for a sea trial that incorporates the new development process and approach capabilities. Pursue steps associated with OMG/OASIS acceptance.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: High availability, high throughput and low latency improvements to commercial data exchange standards allows time critical and real-time systems such as telecommunications, industrial automation and commerce to utilize low cost solutions.

REFERENCES:
1. Object Management Group consortium home page: www.omg.org.

2. Organization for the Advancement of Structured Information Standards home page: www.oasis-open.org.

KEYWORDS: Semantic web, microformats, natural language search, data-mining, machine learning, recommendation agents, artificial intelligence, network, SOA, Web Technologies, real time, protocol, data mediation, baseline management.

N08-184 TITLE: Automated System (H/W & S/W) Test and Repair Tool

TECHNOLOGY AREAS: Information Systems, Materials/Processes

ACQUISITION PROGRAM: PMS450 - VA CLASS Submarine Program; ACAT !

OBJECTIVE: Develop a distributed monitoring system to automatically detect, identify and repair system problems (S/W & H/W).

DESCRIPTION: Verifying and maintaining the integrity of today’s Submarine combat system has become time consuming and can not guarantee full coverage of all potential Software and Hardware (including power supplies, servers, raids etc) failed states. This situation leads to the possibility of system failure during mission critical operations. Therefore a new generation of system integrity verification tools and testing methods is required.

Additionally developing a system to continually monitor the integrity of a system would facilitate and provide metrics, which could be used to determine trends for future systems.

PHASE I: Architect a reusable test automation system that provides an environment for a non subject matter expert for validating a distributed system (S/W & H/W) can be developed, maintained and function as expected.

PHASE II: Develop a prototype distributed monitoring system which will verifies the integrity of the system as well as provide real time solutions to the non subject matter expert for resolutions of mission critical functions. Additionally, generate a report on the number and types of errors found, the potential severity of those errors if they had not been detected and expected conditions under which those errors would have been generated during mission critical system operations.

PHASE III: Prepare commercially viable package that will support the requirements of phase II.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This product would have applicability to all complex, large-scale systems. Key areas of interest include transportation, shipping and medical industries.

REFERENCES:
1. Jain, Navendue, et al, INSIGHT: A Distributed Monitoring System for Tracking Continuous Queries, Department of Computer Sciences, University of Texas at Austin.

2. Rana, Abhishek, A Globally Distributed Grid Monitoring System to Facilitate High-Performance Computing at D?/SAM-GRID.

3. Frankowiak, Marcos R, et al, A Petri-Net Based Distributed Monitoring System Using PIC Microcontrollers School of Engineering, Cardiff University, Cardiff, Wales, UK, February 2004.

KEYWORDS: Software, testing, repair, automation, tools, metrics.

N08-185 TITLE: Compact, Low Cost, Highly Reliable, Optical Tank Level Sensing System

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Electronics

ACQUISITION PROGRAM: PMS450 VA Class Submarine, PEO Submarines, ACAT-1D

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Demonstrate the feasibility of an innovative, compact, low cost, reliable, optical tank level sensing (OTLS) system for use aboard submarines and surface ships.

DESCRIPTION: The US Navy currently utilizes magnetic floats and switch assemblies to measure the fluid level of liquid in numerous tanks aboard various submarine and surface ship platforms. These tank level sensors are susceptible to a variety of failure modes due to mechanical deformation, cable and connector flooding, and biological fouling, and are very expensive to maintain and repair. Each installation requires a unique sensor configuration to accommodate variations in tank geometry, resulting in the need to inventory a large and diverse quantity of parts.

In light of this, there is a current need to develop a small, low power, low cost, and highly reliable means to measure the fluid level in submarine tanks. The sensing system should be easily installed and maintained, have the ability to withstand the shipboard environment, and provide tank level accuracy greater than 1% of full scale and operate over pressures ranging from 0 – 500 PSI and temperatures ranging from 0 – 50 ºC. Optical sensors appear to have the necessary robustness and sensitivity to meet these requirements.

PHASE I: Investigate the state of the art in low cost optical tank level sensors/systems. Develop a concept design that includes the complete preliminary sensing system, including sensor technology, sensor processing, cabling and connectors, data display unit, and data telemetry. Show how the proposed sensing system concept will meet the operating requirements and will reduce the parts inventory needed to support diverse installation requirements.

PHASE II: Develop a complete sensing system prototype including sensor head, cabling and connectors, data processing and display, and data telemetry. Demonstrate the complete sensor system performance in both laboratory and in realistic environmental conditions.

PHASE III: Develop a full scale engineering prototype system and support installation for sea trials. Transition the design to full production.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This system could be used in a broad range of military and civilian maritime and aviation applications where monitoring fluid levels in seawater, potable water, fuel, and sanitation tanks are required.

REFERENCES:
1. W. N. MacPherson, M. J. Gander, J. S. Barton, J.D.C. Jones, C.L. Owen, A.J.Watson and R.M. Allen, "Blast-Pressure Measurement With A High-Bandwidth Fibre Optic Pressure Sensor", Meas. Sci. Technol. 11 (2000) 95-102.

2. W. J. Kessler, P.A. Mulhall, S.J. Davis, M.B. Frish and B.L. Upschulte, "Application of Tunable Diode Laser Spectroscopy for Process Analytical Technology (PAT)", IFPAC 2003 Conference, Scottsdale AZ, January 2003.

3. M.G. Allen, K.L. Carleton, S.J. Davis, W.J. Kessler, C.E. Otis, D. Palombo and D.M. Sonnenfroh, "Ultra-Sensitive Dual-Beam Absorption and Gain Spectroscopy: Applications for Near-IR and Visible Diode Laser Sensors", Appl. Opt. 34, 3240 (1995).

4. M.G. Allen, and W.J. Kessler, "Simultaneous Water Vapor Concentration and Temperature Measurements Using 1.31 um Diode Lasers", AiAA J. 34(3), pp. 483-488, (1996).
KEYWORDS: Optical Sensor; Tank Level; Fiber Optic; Submarine; Surface Ship

N08-186 TITLE: <u>Sensitive Passive Radio Frequency Identification (RFID) Tag Development</u>

TECHNOLOGY AREAS: Information Systems, Sensors

ACQUISITION PROGRAM: Navy Automatic Identification Technology (AIT) Program Office - not ACAT

OBJECTIVE: Navy desires an innovative Passive Radio Frequency Identification (pRFID) tag (transponder) design that will operate with a reader that requires a power level of .25mW or less to meet HERO and safe separation distance capable of a close to touching standoff criteria for operation in the near proximity of ordnance assets and readable within a 3-4 meter range performance. Although there are ongoing studies within DoD to obtain HERO, HERF, HERP & E3 safety parameters, there has never been actual development, testing, and prototyping of a pRFID tag for this purpose.

DESCRIPTION: The safe movement, handling, storage, and positioning of ordnance is a key area of technology investment for the DoD. Passive RFID technology is being integrated across the DoD, and the Navy lacks a solution that can safely operate in ordnance environments especially afloat while providing the improved visibility needed to support its mission. This effort will require a thorough understanding of the principals and physics behind electromagnetic energy and the performance and properties of radio frequency waves. The Contractor will have to employ innovative and creative engineering solutions to overcome currently designed passive RFID readers and tags with specific physical limitations.

An initial study of the science behind RFID makes a successful tag design operating under .25mW a technological challenge. Current COTS pRFID technology requires higher output powers for tags to respond than that considered safe for operating in ordnance environments. Passive RFID Readers (interrogators) can attenuate Radio Frequency power to meet shipboard and HERO constraints. However, pRFID tag performance is reduced to unusable in short read range distances. The greatest current limitation to pRFID performance is tag design requiring RF transmitted energy in excess of .25mW. Optimized tag performance should be 3-5 feet with combined estimated radiated power levels (of all tags and readers in a location) not to exceed .25mW. The four issues concerned with pRFID under decks onboard Navy ships (HERO, HERF, HERP, and E3); ordnance (i.e. HERO) safety has the most stringent limitations. Naval engineering test facilities have indicated that pRFID readers that are operating at or below .25mW could be safely operated in interior decks and compartments of Navy ships.

Previous testing of pRFID readers and tags onboard USS NASSAU (LHA-4) and at engineering test facilities determined that a separation distance of 11’ is required for the safe use of pRFID in the receipt, stow processing of Ordnance which is subject to HERO constraints in and around other material that may be present. This restriction limits the automated receipt and issue processing of material as loaded and unloaded from the fleet. In fact, lessons learned concluded that currently available pRFID readers would have to be turned off to maintain a safe separation distance from ordnance being received aboard ship, since they do not operate at an acceptable level of power and frequency.

PHASE I: Compile a report with recommendations and performance capabilities to achieve a zero or close to touching safe separation distance or standoff pRFID tag. The report would include the feasibility of tag and antenna designs that could operate in a .25mW or less power levels, while meeting the range requirements. The final report should articulate a design for developing a tag that has the highest probability to demonstrate a HERO Safe with Zero or close to touching safe distance for Standoff of the pRFID tag system. This could lead to a commercially developed design solution for use with ordnance safe pRFID technology. If phase I successfully demonstrates potential, it is expected that commercial industry may have similar interests for an explosive asset tracking capability.

PHASE II: Design, develop and demonstrate a HERO Safe with Zero or close to touching Safe Separation distance pRFID tag system. The technology would undergo HERO testing to validate ordnance safety standards. This should lead to a possible dual use (government and commercial) design for HERO safe pRFID with safe standoff.

PHASE III: If successful, HERO Safe with Zero or close to touching Standoff tags will be required in bulk for all materials within the Navy supply chain located Afloat or in areas requiring ordnance safety. This would enable the DoD and Navy to safely use pRFID technology across the Ordnance supply chain. Since Navy has the most stringent safety testing and certification for HERO, the Navy AIT office has been tasked by USTRANSCOM for DoD, DLA and military services AIT offices to provide passive RFID HERO testing and certification for use in ordnance environments.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Benefits gained through low RF reflective applications have potential application in commercial environments where RF sensitivity is common. Sensitive environments may be government contractor facilities that manufacturer ordnance for the military services, electronics, flammable and Petrol-Chemical, Medical, Pharmaceutical, and other Hazardous Material Industries. Other areas within commercial sector are improved toll collection systems, and enhanced asset management solutions. Superior pRFID tag designs increase systems performance and remain applicable across multiple industries applying pRFID technology for asset receipt, issue, status and inventory tracking applications.

REFERENCES:
1. Department of Defense Instruction (DoDI) 6055.11, (Subj: Protection of DoD Personnel from Exposure to Radio frequency Radiation and Military Exempt Lasers).

2. Naval Sea Systems Command (NAVSEA), Publication OP 3565, Vol. 1 - Technical Manual, Electromagnetic Radiation Hazards (Hazards to Personnel, Fuel and other Flammable Material) and Vol. 2 – Technical Manual, Electromagnetic Radiation Hazards (Hazards to Ordnance).

3. Institute of Electrical and Electronics Engineers (IEEE) C95.1 Subj: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

4. DoD Handbook (MIL-HDBK-464) Electromagnetic Environmental Effects, Requirements for Systems.

5. DoD Handbook (MIL-HDBK-240) HERO Test Guide.

6. NAVSEA Publication OD 30393, Design Principles and Practices for Controlling Hazards of Electromagnetic Radiation to Ordnance (HERO Design Guide).

7. Navy AIT Value Chain Demonstration, (report) dtd 27 January 2006.

8. U.S. Navy RFID Implementation Plan, (report) dtd 26 January 2005.

9. Defense Acquisition Regulations System (DFARS) 48 CFR Parts 211 and 252.

10. EPCglobal Class-1 Generation-2 UHF RFID Protocol V1.0.9.

KEYWORDS: HERO Safe, zero standoff, passive RFID Tag, pRFID, sensitive pRFID design, shipboard pRFID, .25mW pRFID tag performance

N08-187 TITLE: Pressure Sensitive Adhesive (PSA) Development

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: ONR/PMR-51

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a pressure sensitive adhesive that will meet NAVAIR flight qualifications for both rotorcraft and fixed-wing platforms. New adhesive formulations must provide a continuous service temperature from -65ºF to 285ºF for up to 1,000 hours while maintaining a 2 to 8 lb/in width peel strength (as measured by the 180º peel adhesion test method).

DESCRIPTION: The need to increase the performance of new aircraft paint-replacement coatings (e.g. appliqué films) is driving the requirement for better solvent and temperature resistant pressure sensitive adhesive systems to bond these coatings to other surfaces. Current pressure sensitive adhesive are generally restricted to temperatures above 0ºF and cannot withstand higher temperatures above 240ºF. This technology will provide new material systems for pressure sensitive adhesive applications that can be incorporated into aircraft appliqué coatings. The pressure sensitive adhesive systems shall promote easy appliqué film repositioning/removal from aircraft surfaces and minimize adhesive residue on platform substrates.

PHASE I: Demonstrate formulations(s) and formulation process(es) for fabricating pressure sensitive adhesive systems. New formulations must be compatible with low-cost, high-volume roll-to-roll web processing as well as various polymeric appliqué film materials (e.g. polyurethane, nylon, polyimide).

PHASE II: Develop the necessary capabilities and process controls to produce low-cost, high-volume pressure sensitive adhesive systems.

PHASE III: Demonstrate the transition of the developed pressure sensitive adhesives to aircraft appliqué coatings through component demonstration and testing. Compatibility with F/A-18, JSF, V-22, AH-1 and UH-60 systems must be addressed.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Pressure sensitive adhesives would have broad application to commercial aviation if performance requirements can be met with improved processing and higher quality mass production.

REFERENCES:

1. Satas D (ed), Handbook of Pressure Sensitive Technology, 2nd ed, Van Nostrand Reinhold New York, 1989.

2. Test Methods for Pressure Sensitive Tapes, 8th ed., Specifications and Technical Committee of Pressure Sensitive Tape Council, Glenview, IL 1985.

KEYWORDS: Pressure Sensitive Adhesives; Appliqué; Coatings; Paint-Replacement; Roll to Roll; Low-Cost.

N08-189 TITLE: Gloves for diver thermal hand protection in cold water environments

TECHNOLOGY AREAS: Human Systems

ACQUISITION PROGRAM: PMS-NSW

OBJECTIVE: To develop gloves which will provide effective thermal protection adequate to meet most NSW cold water needs while maintaining the required dexterity. As with all equipment, these gloves must be durable enough to survive and function after enduring considerable abrasion, bending, pinching, etc. While active thermal protection will be considered, the primary interest is in passive thermal protection.

DESCRIPTION: One of the more challenging thermal issues for military diving is keeping the divers hands warm during cold water missions and also maintaining the dexterity needed to manipulate equipment and devices throughout the mission. A variety of approaches ranging from passive thermal protection to active systems may have merit.

PHASE I: The contractor shall provide a detailed paper including the science of how this equipment would operate, any technical issues, the material selection, the manufacturing process, and any power supplies that may be needed. This information will be, at a minimum, detailed enough to allow determination of the feasibility of continued funding. This phase shall also include a breadboard demonstration model which will be characterized thermally and mechanically.

PHASE II: The contractor shall provide additional technical information as required, as well as providing working models in sets sized to fit 5-95 percentile male hands. These working models will undergo both unmanned characterization and manned testing either alone or in conjunction with other thermal protection equipment.

PHASE III: The contractor shall complete the transition of the technology to allow its use by NSW cold water diving. It is expected that this technology will have commercial application and would transition to Navy divers as COTS available equipment. It is anticipated that these gloves could be a critical component for thermal protection of NSW divers for the future SDV follow-on acquisition program.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This technology addresses issues that are of concern to both the sport diving and commercial diving. The areas of use include, but are not limited to, under-ice sport or science diving and commercial oil exploration and rig maintenance. Any wet weather activity requiring thermal protection and dexterity could potentially benefit from the proposed research.

REFERENCES:

1. "A Heated Glove System For Use During Special Operations Forces (SOF) Missions," Hyde D, Mints W., Biomedical Research Department, Navy Experimental Diving Unit, Panama City, FL.

2. "Manned Evaluation Of A Prototype Composite Cold Water Diving Garment Using Liquids And Superinsulation Aerogel Materials," Dr. M. L. Nuckols, et al., Navy Experiment Diving Unit, Panama City, FL.

3. “Development And Testing Of Thermal Insulation For Divers,” Bardy E., et al., Center for Research and Education in Special Environments, University at Buffalo, NY.

4. "Regional and total body active heating and cooling of a resting diver in water of varied temperatures," Bardy et al, Journal of Physics D: Applied Physics, 2008. You can view the abstract and purchase this article at http://www.iop.org/EJ/abstract/0022-3727/41/3/035501.

KEYWORDS: Thermal protection; cold water diving; insulation properties; material mechanical properties; glove design; frostbite protection.

N08-190 TITLE: Air-sea flux, Turbulence, Aerosol and Wave Measurement System

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: SPAWAR PMW-180 Operational Effects Program (OEP)

OBJECTIVE: Develop an instrument system to be deployed on a towed drone for the measurement of air-sea fluxes, dissipation rate, wave height, and aerosol characteristics.

DESCRIPTION: The region immediately above the ocean surface is generally inaccessible to most measurement techniques, while it is an important region of high gradients and intense air-sea interactions. The objective is to instrument an existing Navy Meggitt TLX-1 low level height-keeping towed target to obtain measurements at approximately 30 feet above the ocean while the tow aircraft is at a safe higher altitude. The TLX-1 towed target is a streamlined eight inch diameter, five foot long tube with a hemispherical nose with 170 watts at 28 VDC and as payload capacity of 65 pounds. Within these size, power and weight parameters of a TLX-1 towed target, it is desired to obtain very fine-scale measurements of relevant thermodynamic atmospheric variables (three wind components, temperature, and humidity) together with ocean wave height and sea spray aerosol characterization. The technical challenges include development, integration and characterization of the sensors for wind, temperature, pressure, etc. in terms of frequency response and spatial resolution and the measurement of ocean wave spectra, white capping fraction and aerosol loading. An important variable in air-sea interactions, especially at high winds, is the rate of dissipation of kinetic energy. With high-fidelity sensors, this can be estimated from the power spectral level of the velocity components. With simultaneous wave height measurements, the phase-resolved wind and related fields can be determined. Aerosol characterization will enable the source function to be determined over breaking waves. Quantification of measurement errors is critical.

PHASE I: Proof-of-concept effort should result in a description of a high fidelity air-sea-wave-aerosol interaction sensor suite for application on a TLX-1 towed target and analysis of the feasibility of commercializing the final product.

PHASE II: Develop and demonstrate a fully capable instrument suite for use on a Navy provided TLX-1 towed target. Thoroughly test the system, and successfully demonstrate its functionality. Develop a plan for transitioning the package to commercial use. Develop a commercialization (Phase III) plan, including descriptions of potential customers, missions, demonstrations and transition efforts to be performed.

PHASE III: Transition the system into an operational air-sea-wave interaction instrument package to include documentation, calibration and other tools and spare parts. Support sea-wave interaction instruments integration for government customer-specified platforms. Finalize requirements for a sea-wave interaction system that would allow its utilization by various research aircraft.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Benefits to researchers and to research monitoring programs are inherent in the objective of the proposed effort. Commercial applications include oil spill assessment, radar ducting assessment and hurricane reconnaissance.

REFERENCES:

1. Edson, JB and CW Fairall 1998: Similarity relationships in the marine atmospheric surface layer. J. Atmos. Sciences, vol 55, 2311-2328.

2. Hristov, T., C. A. Friehe and S. Miller, "Wave-Coherent Fields in the Air Flow over Ocean Waves - Identification of Cooperative Behavior Buried in Turbulence," Phys. Rev. Letters, 81, no. 23, 5245-5248 (1998).

3. Information of the TLX-1 Towed Target can be found at the Meggitt Defense Systems web site at www.meggittdefense.com.

KEYWORDS: Marine Atmospheric Boundary Layer, surface radar ducting, optical propagation, aerosol measurements, ocean wave measurements, and aircraft towed instrument platform

N08-191 TITLE: Metamaterials for Acoustic Cloaking

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Subs, PMS-450, Virginia Program Office

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The objective of the topic is to develop and demonstrate manufacturing technology for metamaterials that can be used to construct spherical shells that pass acoustic radiation without backscattering and fill in the shadow zone behind the incident field.

DESCRIPTION: Through acoustic scattering theory, Cummer et. al. derived the mass density and bulk modulus of a spherical shell that can eliminate scattering from an arbitrary object in the interior of the shell: in other words, an acoustic cloaking shell. It requires an anisotropic mass density with principal axes in the spherical coordinate directions and a radially-dependent bulk modulus. Techniques to manufacture these exotic “metamaterials” are required to advance the theory and applications of acoustic cloaking technology.

PHASE I: Investigate the concept of using metamaterials to provide acoustic cloaking of objects at frequencies of interest to the U.S. Navy. Summarize with a final report describing the properties of acoustic cloaking metamaterials and a concept for manufacturing them.

PHASE II: Develop a model for materials to exhibit cloaking properties at Naval acoustic frequencies and fabricate a laboratory proof of concept demonstrating the ability to manufacture metamaterials in small lots.

PHASE III: Clearly identify and describe the expected transition of the product/process/service within the government as a result of the Phase II, in which the small business will participate under a Phase III.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The commercial potential of acoustic cloaking material includes suppliers of sound control materials and room designers who want to use advanced materials to control sound propagation within airports, subway and railway stations, conference rooms, classrooms, offices, homes and concert halls.

REFERENCES:
1. J. B. Pendry, D. Schurig, and D. R. Smith, Science 312, 1780 (2006).

2. D. Schurig, J. B. Pendry, and D. R. Smith, Opt. Exp. 14, 9794 (2006).

3. D. A. B. Miller, Opt. Exp. 14, 12457 (2006).

4. H. Chen, B.-I.Wu, B. Zhang, and J. A. Kong, Phys. Rev. Lett. 99, 063903 (2007).

KEYWORDS: Metamaterials, acoustic cloaking, cloaking shells, submarines.

N08-192 TITLE: Comprehensive data-reduction and analysis package for cloud and precipitation particle imager data.

TECHNOLOGY AREAS: Air Platform, Sensors, Battlespace

ACQUISITION PROGRAM: SPAWAR PMW-180 Operational Effects Program (OEP)

OBJECTIVE: Develop software to fast and efficiently process particle images from modern 2-D or 3-D atmospheric hydrometeor imaging systems and determine their size and concentration, and automatically classify them into conventional meteorological groups according to shape and phase.

DESCRIPTION: Recent advances in electronics have been implemented in 2-dimensional and 3-dimensional aerosol and cloud particle detection and imaging instruments to enhance their accuracy, speed, and resolution. The data throughput and signal processing effort from these instruments, however, is enormous and requires much time and manpower for data reduction and analysis. The various user groups individually develop their software analysis packages, often making it difficult to verify result or compare the results from different instrument users. The signal processing and data reduction techniques clearly need be standardized so measurements obtained by using the imagining probes may be of value. The software package envisioned here is to automate this signal interpretation and data reduction process, reduce processing time, increase confidence in the results, and through image recognition techniques (similar to those currently used by oceanographers to classify and identify biological microbes in the water) automatically group particles such as ice crystals into the basic meteorological groups of say spheres, plates, columns, needles. This however is recognized as not being a simple task, because "no two ice crystals are alike". Nevertheless, attempting to systematically recognizing and classifying "classes" of particle shapes, and generating measured class descriptors The package must be user friendly, and be able to run by non-experts on common desktop computers to produce graphic displays of size distributions, shape histograms and such. A desirable feature would be that the package were not probe or sensor specific, but had the capability of processing data from various commonly available sensors.

PHASE I: Proof-of-concept effort should result in a skeletal design structure with some crudely operable components (data read interface, some form of a shape recognition scheme, summary display graphics), and analysis of the feasibility of commercializing the final product.

PHASE II: Finalize the various software components, combine them into a comprehensive, user friendly, menu driven, package. Integrate the package to real data and generate presentable graphical displays of results. Thoroughly test the system, and successfully demonstrate its functionality. Develop a plan for transitioning the package to commercial use.

PHASE III: Transition the system into operational cloud physics instrument to include documentation, calibration and other tools and spare parts. Support the cloud physics instrument integration for government customer-specified platforms. Finalize requirements for a cloud physics instrument system that would allow its utilization by various research facilities on a variety of platforms, including aircraft, ships or ground based operations.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: The 2-D and 3-D particle imaging systems have be rapidly evolving and improving in recent years. Their use is both in research and in monitoring aerosol, cloud, precipitation events. Generally the individual users develop their own crude data reduction and analysis tools. Availability of a successful, professional, software package for that purpose will replace much such effort. Along with simplification of measurement and data handling technologies has been an increasing trend for private companies to provide science support, both with airplanes and with measurements. Although presently cloud and precipitation research is mostly supported by air vehicles and instrumentation in the hands of government agencies and universities, private businesses already are beginning to provide such services.

REFERENCES:
1. Lawson, P., D. O'Connor, P. Smartly, K. Weaver, B. Baker, Q. Mo, and H. Jonsson, The 2-D stereo Probe: Design and preliminary tests of a new airborne, high-speed, high-resolution, particle imaging probe, J. of Atmos, and Ocean., Tech., Vol 23, 1462-1477, 2006.

2. Baumgardner, D., H. Jonsson, W. Dawson, D. O'Connor, and R. Newton, 2001: The cloud, aerosol, and precipitation spectrometer (CAPS): A new instrument for cloud investigations, Atmos. Research, 59-60, 251-264.

KEYWORDS: Aerosol, Cloud, Precipitation, Software, Data Analysis

N08-193 TITLE: Tactical Bioluminescence Navigation Aid

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Battlespace

ACQUISITION PROGRAM: PMS NSW

OBJECTIVE: Develop a navigation aid for underwater vehicles that will sense bioluminescence triggered by the vehicle and local environmental information (e.g., water optical properties and ambient light), ingest the data into a realistic hydrologic optics model capable of propagating the bioluminescence to and through the water surface, and provide the navigator (autonomous or manned) with a real-time assessment of detection probability by an above-water observer.

DESCRIPTION: Covert, underwater navigation in coastal and estuarine waters is often compromised by bioluminescence from marine phyto- and zooplankton, triggered by turbulence generated by the underwater vehicle. If the vehicle it close enough to the surface and if the bioluminescence is bright enough, the stimulated light can be observed above water. This project will 1) develop a simple, compact, robust, low-power approach to monitor bioluminescence intensity (BI), water optical properties (OP), and ambient light, 2) develop a simple radiative transfer model that will ingest the sensor data in real time, propagate the stimulated light to and through the water surface, and contrast the signature with above-water ambient light conditions and 3) develop a simple navigation aid that will provide the vehicle control system in real time (automated or manned) the bioluminescence detection probability based on the estimated water-leaving signature. The system should be as compact and conceptually simple as possible. For example, simple radiometers, strategically placed on the platform, could simultaneously measure the ambient light field and platform-induced bioluminescence directly. The radiative transfer model should be analytically simple and capable of residing on a specialized chip within the circuitry. The display should be graphical and easily understood at a glance.

PHASE I: Develop a detailed description of the TBNA; determine the feasibility of the proposed sampling and modeling methodology; provide a concept for a real-time display in the case of a human operator; estimate the production cost for the system (excluding integration into the target platform).

PHASE II: Develop and evaluate prototype sensors, develop and evaluate a radiative transfer modeling construct; develop and evaluate prototype real-time graphical displays of detection probability; demonstrate an end-to-end system concept, including detection probabilities for realistic platforms in reasonable coastal and estuarine scenarios.

PHASE III: Produce and field test a beta-version of the TBNA under a range of conditions and demonstrate system utility within an appropriate Fleet exercise.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Sensors should have civilian application to monitoring nearshore or estuarine water quality, for example, as a tool for detecting harmful algal blooms. Sensor could be used to complement environmental assessment activities, including habitat evaluation. A small, inexpensive, easily-deployed sensor suite will offer similar advantages to non-DoD users.

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2. Trees, C.C., P.W. Bissett, H,. Dierssen, D.D.R. Kohler, M.A. Moline, J.L. Mueller, R.E. Pieper, M.S. Twardowski, and J.R.V. Zaneveld. 2005. Monitoring water transparency and diver visibility in ports and harbors using aircraft hyperspectral remote sensing. Prodeedings from SPIE Port and Harbor Security Conference, Vol. 5780, February, Orlando, FL.

3. Twardowski, M.S., J.R.V. Zaneveld, C.M. Moore, J. Mueller, C. Trees, O. Schofield, S. Freeman, T. Helble, and G. Hong. 2005. Diver visibility measured with a compact scattering-attenuation meter (SAM) compatible with AUVs and other small deployment platforms. Prodeedings from SPIE Port and Harbor Security Conference, Vol. 5780, February, Orlando, FL.

4. Edith A. Widder, E.A., Latz, M.I., And Case, J. F. 1983. Marine Bioluminescence Spectra Measured With An Optical Multichannel Detection System. Biol Bull 165: 791-810.

KEYWORDS: Bioluminescence, radiative transfer, tactical navigation aid.

N08-194 TITLE: <u>Tethered Antennas for Unmanned Underwater Vehicles (UUVs)</u>

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: PMS-480/N857 Integrated Swimmer Defense Program of Record. ACAT IV

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop a tethered antenna for a UUV that will support two-way RF communication and GPS reception. The inspiration being the floating wires and communication buoys utilized by submarines.

DESCRIPTION: UUVs are used in many applications where the placement of a sensor underwater is required. Examples include bathymetric survey and mine detection systems. The UUVs generally navigate via an inertial navigation unit that is fixed to GPS prior to diving or acoustically via transponders in fixed locations. The underwater regime limits the UUV’s ability to communicate, the available options being low data rate acoustics, hard tethers back to an operator, or latent RF communications as the UUV periodically comes back to the surface. The ability to communicate rapidly while still submerged could be very beneficial to many applications and the Terminal Swimmer Detection and Targeting (TSDT) Future Naval Capability (FNC) application in particular. In this case the UUV would have to effect an intercept of a moving target under the guidance of a remote detection system. A tethered antenna that will support two-way RF communication and GPS reception would greatly enhance the ID and localization capabilities of such a system. The floating wires and communication buoys utilized by submarines provide inspiration.

PHASE I: Design and demonstrate through simulation or limited testing the potential to develop a tethered antenna. This phase may or may not include actual hardware testing.

PHASE II: Demonstrate submerged communication performance through employment of an actual UUV or a realistic surrogate. This phase will include development of hardware. A completely functional prototype is not required; however, the feasibility and the expected performance of a fully operational antenna system should be clearly evident within the demonstration.

PHASE III: A successful antenna system coupled to a capable UUV has the potential to transition into the Maritime Expeditionary Security Force (MESF) Swimmer Defense Program of Record, Integrated Swimmer Defense (ISD) system. SECRET clearance may be required for Phase III.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: UUVs are developing an ever wider user and capability base. The option of tethered on RF should prove useful in many applications. The more specific underwater ID and localization of potential intruders has applicability to homeland defense, law enforcement, and private-security systems.

REFERENCES:

1. Assessing the Risk in U.S. Ports, Marine Technology Reporter, September 2005 (Available at: http://www.mtronline.net/MTIssues/mt200509o2.pdf).

2. New Tech on Tap at AUV Fest '05, Marine Technology Reporter, September 2005 (Available at: http://www.mtronline.net/MTIssues/mt200509o2.pdf).

3. ONR BAA Announcement # 07-019, Terminal Swimmer Detection and Targeting (Available at: www.onr.navy.mil/02/BAA/docs/baa_07_019.pdf).

4. M. Kono, "Winding and packing of optical fiber for deployment from remotely controlled underwater vehicles", Proceedings of the winter annual meeting of the American Society of Mechanical Engineers, November 1981.

5. High-Strength, Long-Length Optical Fiber for Submarine Communications at Speed and Depth, Navy SBIR 2008.1 - Topic N08-095 (Available at: http://www.navysbir.com/n08_1/N081-095.htm).

KEYWORDS: AUV; UUV; Communications; Antennas; Tether; GPS.

N08-195 TITLE: Next-Generation Marine Atmosphere Observing Instrumentation

TECHNOLOGY AREAS: Sensors, Battlespace

ACQUISITION PROGRAM: PEO C4I, PMW120-3A2 DAPM Future MetOc Systems

OBJECTIVE: Develop next-generation sensors to autonomously measure atmospheric parameters at lower cost, higher temporal and spatial resolution, and at lower weight/power/volume to increase utilization of new platforms and technologies.

DESCRIPTION: Current in-situ atmospheric observing systems are insufficient for providing inputs to high-resolution, tactically relevant forecast systems. Innovative sensors and measurement techniques are solicited to obtain atmospheric and oceanographic environmental variables at higher temporal and spatial resolution and at reduced cost and size/weight. The goal is to sense fully constrained atmospheric state variables at vertical scales of order 1 meter, horizontal scales of order 1 kilometer, and temporal scales of order 10 minutes, in challenging conditions such as tropical cyclone eyewalls, sea breeze fronts, and convective outflow boundaries. While prototype technologies such as dual polarized radars, differential absorption and Doppler wind lidars, and microdropsondes show promise, these current efforts are either not fully operationalized in terms of cost, data exfiltration and cross-platform employability, not of sufficient accuracy and reliability for routine operations, or do not sense both the momentum and thermodynamic properties coincidently at sufficient four dimensional resolution for current Defense Operations and Research challenges.

Emphasis is placed on (1) novel approaches, concepts, and exploitation of new technologies for measuring environmental parameters coherently in 4-D either through remote sensing approaches or through reduction of expendable per unit costs, (2) observations which can be conducted autonomously on aircraft, UAVs, ships, buoys or with unattended or expendable instruments and can pass the data back in real time to central site without requiring in-situ receipt and archival recording, (3) providing a significant reduction in instrument weight, volume and power without reducing fidelity or resolution as compared to current state-of-the-art devices, and (4) developing improved instrumentation usable in both Navy operational scenarios as well as in S&T environmental data collection.

Examples of some of the types of measurements solicited include advancements to atmospheric thermodynamic sounding technologies for improved resolution and employability at reduced cost; improved aerosol, cloud, optical, thermodynamic, or turbulent properties in marine environments especially in high winds; reduced cost expendable sounding instrumentation; through-the-sensor methods for improved exploitation of operational sensors; and accurate measurement of temperature, humidity, wind, and wave properties near the surface in extreme conditions.

PHASE I: Provide an exact description of the parameter or coincident parameters to be measured including accuracy and sensitivity along with a design concept for achieving the measurement.

PHASE II: Produce a viable prototype system and demonstrate its ability to support field measurements from an appropriate platform to include data retrieval and transmission.

PHASE III: Transition the technology to scientific use in the atmospheric, oceanographic or environmental monitoring research communities, and operational DOD systems.

PRIVATE SECTOR COMMERCIAL POTENTIAL: There is a need for real-time ocean/ atmosphere data by the Defense Department and Commercial sector. New instruments can be used in a wide variety of commercial environmental observing systems as well as mobile platforms.

REFERENCES:
1. Conference Proceedings, National Science Foundation User's Workshop (NSFUW), Boulder, CO, September 24-26, 2007. Available from http://www.eol.ucar.edu/nsfuw2007. Identified the consensus atmospheric research community's priority need for a rapidly deployable, lower cost per unit, high vertical and horizontal resolution, thermodynamic measurement system to replace the current generation technologies such as weather radars and rawinsondes.

2. Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead, February, 2007, FCM-P36-2007. Available from http://www.ofcm.gov/p36-isrtc/fcm-p36.htm. Identified a need for passive (microwave) and active (polarimetric radar, lidar) sensors for 2-D ocean vector winds, waves, and currents and 3-D winds, aerosols, precipitation, water vapor, temperature and pressure using new technologies to achieve smaller, lighter, lower power sensors for airborne, ship-based, and UAV deployment in high risk environments.

3. Conference Proceedings, Rapid Environmental Assessment, Lerici, Italy, September 25-27, 2007. Available from http://geos2.nurc.nato.int/mreaconf/ including related references. Discusses the Defense requirements from a NATO perspective of high impact mesoscale weather and the sensing and modeling challenges still unfilled with current technologies.

KEYWORDS: meteorology; oceanography; sensors; instruments; automation; expendable

N08-196 TITLE: <u>An Asynchronous SINCGARS (Single Channel Ground and Airborne Radio System) Frequency Hopping Notch Filter Based on Canceller Technology</u>

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors, Battlespace

ACQUISITION PROGRAM: PEO-C4I Ships Signal Exploitation Equipment (SSEE) Increment E, ACAT III

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: Develop electronically tuned SINCGARS (Single Channel Ground and Airborne Radio System) hopping notch filters using canceller or other asynchronous technology that will suitably remove all interference (including multi path) from up to 8 SINCGARS co-located interfering radios. This would allow SIGINT systems to receive low level signals in the SINCGARS frequency band while up to eight of these SINCGARS radios are operating. The desired rejection of the SINCGARS (Single Channel Ground and Airborne Radio System) signals is 30 dB threshold and 50 dB objective.

The objective of this task is to develop asynchronous SINCGARS (Single Channel Ground and Airborne Radio System) hopping filters that can reject 8 or more SINCGARS radios operating simultaneously at a maximum input of 1 Watt with a goal of 50 dB rejection of these signals (30 dB minimum) and a maximum filter -6 dB notch width of 2 MHz with a goal of less than 1 MHz. The size of a single channel device is limited to a 7u height of a standard 19 inch equipment rack. To reduce complexity and possible security issues, it is desired for this system to operate independent of a tuning signal or any other output from the SINCGARS (Single Channel Ground and Airborne Radio System)radio. It is expected that this may be accomplished by using adaptive signal canceller technology or other advanced filter technology. A possible method of implementation would be to utilize the interfering SINCGARS (Single Channel Ground and Airborne Radio System) signal as the reference signal for a canceller system. Artificial Intelligence or other digital learning methods could be used to “remember” cancellation weights versus frequency to ensure rapid cancellation and filtering. Separate cancellers may be required for discrete portions of the SINCGARS (Single Channel Ground and Airborne Radio System) band to insure 8 or more transmitters can be cancelled while minimally affecting the remainder of the band.

DESCRIPTION: Navy SINCGARS (Single Channel Ground and Airborne Radio System) systems are required to receive low level signals in the HF, VHF and UHF frequency bands usually on multiple channels to provide direction finding capability. The SINCGARS (30-88 MHz) band occupies part of the VHF frequency band where signal reception is required. U.S. Navy ships will have from 2 to 8 SINCGARS transmitters installed, which are used to communicate with shore operational units. SINCGARS (Single Channel Ground and Airborne Radio System) radios use a frequency hopping signal to prevent jamming and interception, which is difficult to remove and prevent electromagnetic interference to the SIGINT receivers. Current SINCGARS (Single Channel Ground and Airborne Radio System) systems use signal cancellers or frequency hopping filters to remove this signal. Cancellers require a sample of the transmitted signal as well as individual canceling stages for each transmitter and respective multi-path signals. This method has the advantage of only canceling the interfering signal allowing reception of low level signals in the entire band. It has the disadvantage of complexity due to the required aforementioned sampling numerous canceling stages needed for each radio including its multi-path signals. Frequency hopping filters also require synchronization with each transmitting radio in order to tune the filter to the expected hop frequency. This technology also has the disadvantage of high complexity; a hopping filter for each transmitter and synchronization with each transmitter is required. Due to the complexity required to eliminate the SINCGARS signals both of these methods are usually limited to only 2 or 3 SINCGARS (Single Channel Ground and Airborne Radio System) interferers.

Currently interference cancellers are used to remove frequency hopping signals but typically, because the canceller size doubles for each signal cancelled and each multi-path signal, cancellation is limited to one or two co-located signals. This proposal is innovative because it attempts to merge canceller and hopping filter technology into a hybrid stand-alone hopping filter that can eliminate up to 8 co-located SINCGARS signals; will be independent of transmitter outputs; and will maintain performance in the presence of multi-path signals combining at the antenna.

PHASE I: Conduct an analysis of the proposed technologies/architecture to predict the expected notch filter performance over the required frequency range. Develop a concept for how such a filter network could be constructed to meet surface ship requirements. Develop a filter simulation to demonstrate the concept and validate performance. Develop a plan for the development of the required capability including cost, schedule, and required support.

PHASE II: Develop a full-scale prototype and demonstrate the ability to meet threshold objectives with the prototype filter network. Develop a production plan to manufacture fully military (USN ship) qualified versions of the product in the smallest form factor possible.

PHASE III: Develop a highly reliable, fully military specification compliant system, meeting objective requirements suitable for the intended employment on board Navy surface combatant ships. Fully developed system must effectively integrate with shipboard tactical crypto logic and communication systems. The system will meet all applicable EMC and RA requirements.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: This tunable filter technology will encourage the development of additional filter technologies and architectures that will be of great interest to both military and commercial organizations. Tunable filter technology can be used to great advantage to extend communications range, reduce interference, allow more dense frequency re-use, and reduce the effects of multi-path. These benefits apply equally for military and civilian applications. Military applications of this technology could be extended to remove other hopping transmitter interferers including JTIDS/MIDS and Havequick.

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1. Lee A. Q. et al. “An evaluation of collocation interference mitigation approach SINCGARS radios". Military Communications Conference, 1995. MILCOM '95, Conference Record, IEEE.

2. Kub, F.J. et al. “Self Calibrating Hybrid Analog CMOS Co-Site Interference Canceller". Military Communications Conference Proceedings, 1999. MILCOM 1999. IEEE.

3. Lee, Thomas H. 2004 Planar Microwave Engineering. New York, NY: Cambridge University Press.

KEYWORDS: Tunable hopping filter; Canceller; SINCGARS; VHF; Cancellation; Havequick.

N08-198 TITLE: Topology Management for Directional Antenna-based Networks

TECHNOLOGY AREAS: Information Systems

ACQUISITION PROGRAM: PMW-170 Communications ACAT III

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.5.b.(7) of the solicitation.

OBJECTIVE: The objective of this SBIR effort is to research advanced approaches for a readily deployable Topology Management algorithm(s) which address the complexity of mobile Ad Hoc Mesh Communication Networks constructed of directional antennas, and demonstrate its ability to optimize total network carrying capacity in a tactical ad hoc environment with unbalanced traffic.

DESCRIPTION: Wideband tactical radios are rapidly expanding into non-traditional roles in support of the Department of Defense vision for a connected force supported by a wireless backbone capable of supporting both ISR and C4 types of communication. The FORCEnet/Global Information Grid vision for warfighter connectivity is largely dependent on network connectivity and reliability. Various algorithms for topology management in advanced ad hoc mobile networks exist, but make simplifying assumptions (e.g., regarding traffic flows) which results in a suboptimal network topology for military network traffic loads produced by the mixing of ISR and C4 applications. This is particularly true as the communications move from the use of omni and sectored-omni antennas to directional antennas.

Current radio and waveform developments are diverse and specialized in their approaches to network management. Most depend on specific hardware implementations to support topology management of a homogenous network and are not compatible with existing radios requiring replacement of equipment. The goal of this effort is to develop (1) a topology management (TM) algorithm which can be readily deployed with little hardware modification to existing systems, and (2) a defined set of messages which will be exchanged between the entities implementing the TM function. The desired topology management algorithm must efficiently optimize the military application directed network topology, and must be compatible with the existing routing systems (e.g., ADNS) which are based on commercial protocols. Efficient algorithms for rapidly changing, highly dynamic networks should be included in this research. This network is much more complex than an infrastructure backed network and topology management will be key to maintaining warfighter connectivity.

PHASE I: Phase I will include research and development on topology management algorithms and provide a conceptual design of a topology management algorithm that can optimize bandwidth allocation when used with wireless tactical radios that use directional (narrow-beam) antennas in the presence of unbalanced loads. The capability must be able to manage at least one hundred fifty heterogeneous, wireless radios. The study must consider all pertinent operating data such as, but not limited to, radio inputs/outputs, power requirements, terrain data, antennae characteristics, data exchange, world-wide environmental conditions, network traffic loads, and multiple security domains. The algorithm should adapt to various military traffic loads, interoperability scenarios, enemy/threat representations and capabilities, etc. The research study should assume that routing will be performed using OSPF v3 with MANET extensions.

PHASE II: Phase II would require development of a software model to simulate the directional antenna-based network topology and test topology management algorithms in a simulated environment. Simulations would be used to validate usability and effectiveness of the topology management algorithm for networks consisting of more than 100 nodes. Traffic loads should be considered in this phase as well as several realistic operational scenarios such as entry and exit from the network, prioritization management, and physical attributes impacting topology management of the network (i.e. various altitudes, speeds, and antenna attributes).

PHASE III: Complete TM implementation for integration into a network environment. The TM would be installed and tested in an operational environment. A final list of required system performance capabilities will be included.

PRIVATE SECTOR COMMERCIAL POTENTIAL/DUAL-USE APPLICATIONS: Commercial applications include the growing need for mobile networking in cell phone, pda, laptop, and other personal computing devices. Topology management for diverse mobile networks include uses in commercial aircraft, police ad hoc networks, and disaster relief efforts.

REFERENCES:

1. Approximation Algorithms for Dynamic Resource Allocation; Vivek F. Farias, Stanford University; Benjamin Van Roy, Stanford University, March 8, 2005.

2. Topology Management in Ad Hoc Networks, Lichun Bao, University of California Santa Cruz, J.J. Garcia-Luna-Aceves, University of California Santa Cruz, Proceeding of the 4th ACM international symposium on Mobile ad hoc networking & computing, pp. 129-140, 2003.

3. Topology Managemetn in CogMesh: A Cluster-based Cognitive Radio Mesh Network, Tao Chen, Honggang Zhang, Gian Mario Maggio, and Imrich Chlamtac, ICC 2007 proceedings.

KEYWORDS: Topology Management; algorithm; MANET; Ad Hoc; Directional Network

N08-199 TITLE: Imaging Instrumentation System

TECHNOLOGY AREAS: Sensors, Electronics, Battlespace

ACQUISITION PROGRAM: Strategic Systems Programs

OBJECTIVE: Develop an instrumentation system that collects and exploits data captured in broad ocean areas to generate aberration-corrected three-dimensional image time sequences of multiple, near-simultaneous surface impact events.

DESCRIPTION: Strategic Systems Programs (SSP) has successfully fielded portable scoring systems for the time-difference-of-arrival geolocation of Trident II D5 weapon system munitions deployed for testing in broad ocean areas. In addition, new real-time acoustic scoring systems have been field tested to support the evaluation of precision guided munitions, using similar scoring techniques, but for single impacts. Development of new Trident II D5 weapon system capabilities with multiple, near simultaneous impacts significantly complicates the processing problem presented by many different acoustic paths and therefore requires a different approach or a significant advancement of sensor and processing technologies to support weapon system evaluation in broad ocean areas.

The system developed should support potential open ocean target areas of at least 500 meters radius, with sub-meter event resolution near the center of the target area, and should be capable of resolving near-simultaneous (<1 second) of up to 500 distributed impacts per test. Standoff distances could be expected to be 10 nautical miles or more.

Absolute accuracy of the capability should be better than one meter (1 sigma) referenced to the WGS-84 reference ellipsoid.

With 500 or more submunition impacts occurring in less than one second over an area of 500 meter radius, the complexity of detecting each impact and localizing it increases the problem exponentially. Separating and tagging each impact and localizing each to within one meter cannot be achieved with existing technology; therefore requiring a new, innovative approach. R&D is needed to extend multiple capabilities (detection, separation and accurate localization) in this area.

Should the data collection system require an array of sensors, they should be expendable and the total cost for all sensors per system must be less than $25K. Sensors should be deployable by unmanned or manned aircraft in quantity.

PHASE I: Identify required technologies, and develop a preliminary design for the capability. Develop a detailed description of any algorithms. Perform an initial performance and unit cost estimate.

PHASE II: Develop a fieldable prototype instrumentation system. The fieldable prototype should be capable of demonstrating all core technologies and supporting evaluation of performance estimates developed in Phase I. Demonstrate the performance of the system in a controlled body of water, including the collection of data and post-processing of those data. Evaluate the prototype instrumentation system and identify any remaining key performance parameters that have yet to be achieved.

PHASE III: Work with existing SSP support contractors to support validation testing of the instrumentation system in an actual weapon test environment. Any expendables used in the system should be produced in sufficient quantity to support testing and fielded with support equipment required for data collection and post-processing.

PRIVATE SECTOR COMMERCIAL POTENTIAL: The ability to accurately localize multiple object impacts on the surface of a body of water can serve a number of environmental and oceanographic research activities, provide precise localization of underwater objects for underwater search and rescue, and support ship and harbor security applications. Additionally, the signal processing aspects can be applied to other types of sensor nets such as ground-based seismic sensing, remote, automated weather stations and sea life monitoring.

REFERENCES:
1. Cardoza, M., Kayser, J., Wade, W., "Offshore Scoring of Precision Guided Munitions Using a Tactical Acoustic Realtime Geolocation System", Inside GNSS, April 2006.

2. Cardoza, M., Kayser, J., Wade, W., et. al., "Weapon Scoring Results from a GPS Acoustic Weapon Test and Training System", Institute of Navigation National Technical Meeting, San Diego, California, January 24-26 2005.

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4. Saunders, J. and Cardoza, M., "Preliminary Results from a GPS-Based Portable Impact Location System", Proceedings of the Institute of Navigation's Satellite Division Meeting, ION GPS-95, Palm Springs, California, 12-15 September 1995.

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KEYWORDS: sensor; miniature; acoustic; adaptive acoustic imaging; GPS; signal processing

N08-200 TITLE: Determination of SSBN ownship ground velocity

TECHNOLOGY AREAS: Ground/Sea Vehicles, Sensors

ACQUISITION PROGRAM: Strategic Systems Programs

OBJECTIVE: Develop an innovative approach (sensor, and/or algorithm, and/or system) to determine the ground velocity of submerged submarines while minimizing the amount of detectible energy transmitted. Determine this sensor system's adaptability to the wide range of ocean conditions such as ocean depth, bottom slope, reflectivity and other operational conditions. Optional system modes with capability to measure other parameters useful to navigation (e.g.: recognition of a particular bottom profile) are also desired.

DESCRIPTION: The operations of the U.S. Navy's submarine fleets depend on accurate navigation solutions to achieve success. The inertial navigation systems outputs can be maintained at a high accuracy through use of an accurate ground velocity reference such as a sonar device. Innovations are needed in the areas of sensor technology, signal processing algorithms, system design, or other methodologies and technologies that maintain ground velocity reference while the ship is maneuvering at various speeds, depths, turn rates, and while minimal detectible energy is transmitted to the water. Current implementations are such that accurate ground reference velocity can not be maintained for high ship's speeds, with roll or pitch motion and with large bottom slope. Capabilities are also very limited in terms of maintaining ground reference velocity for large depths without giving up the ship's covert operations. Therefore R&D is necessary to extend performance into these areas.

PHASE I: Develop the conceptual ground measuring sensor system and derive the architecture of an approach to realize the conceptual system. Perform an analysis of the system to determine performance boundaries of a trade space defined by the following parameters: ground velocity accuracy, ship's roll & pitch motion, ship's speed, bottom slope, bottom reflectivity, depth, and covertness. (Covertness will be a measure of the amount of energy dispersed at an angle parallel to the surface.) Develop a plan to develop a prototype system for construction and testing in Phase II. This system should include the more risky aspects of the sensor design and the test results should be able to be used to extrapolate the performance of a full system.

PHASE II: Identify major system design issues (installation, system performance, system maintenance and alignment and system cost). Develop the prototype system of the approach developed in Phase I. Test and demonstrate performance of the system. Investigate the feasibility of installing a complete sensor system on current submarines using information provided by Strategic Systems Programs at that time.

PHASE III: Integrate the new ground velocity system into an inertial navigation system and demonstrate the added performance value above the inertial system alone.

PRIVATE SECTOR COMMERCIAL POTENTIAL: Submersible vehicles, manned and autonomous, often cannot maintain a GPS connection. The ability to have an accurate navigation solution can have a significant impact on the accomplishment of long term missions without leaving station or being tethered to the deployment ship. This includes cable laying, coastal mining operations, and salvage and rescue operations. With a bottom profiling capability, another application would be undersea oil exploration and high definition sea floor geographic surveys.

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KEYWORDS: submarine; sonar; sensor systems; signal processing; sensor fusion; velocity reference; beamforming